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MATERIAL RECYCLING

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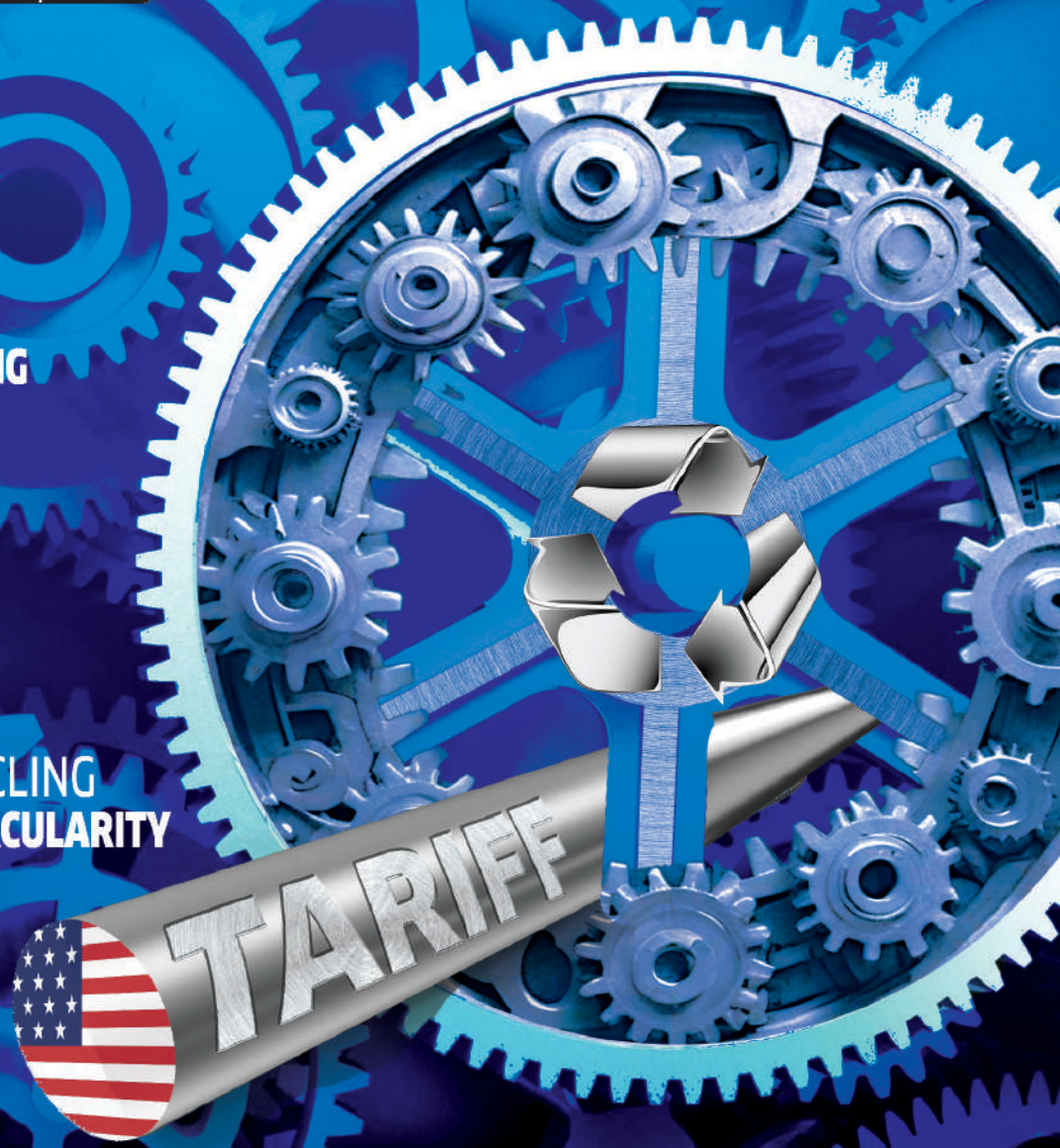

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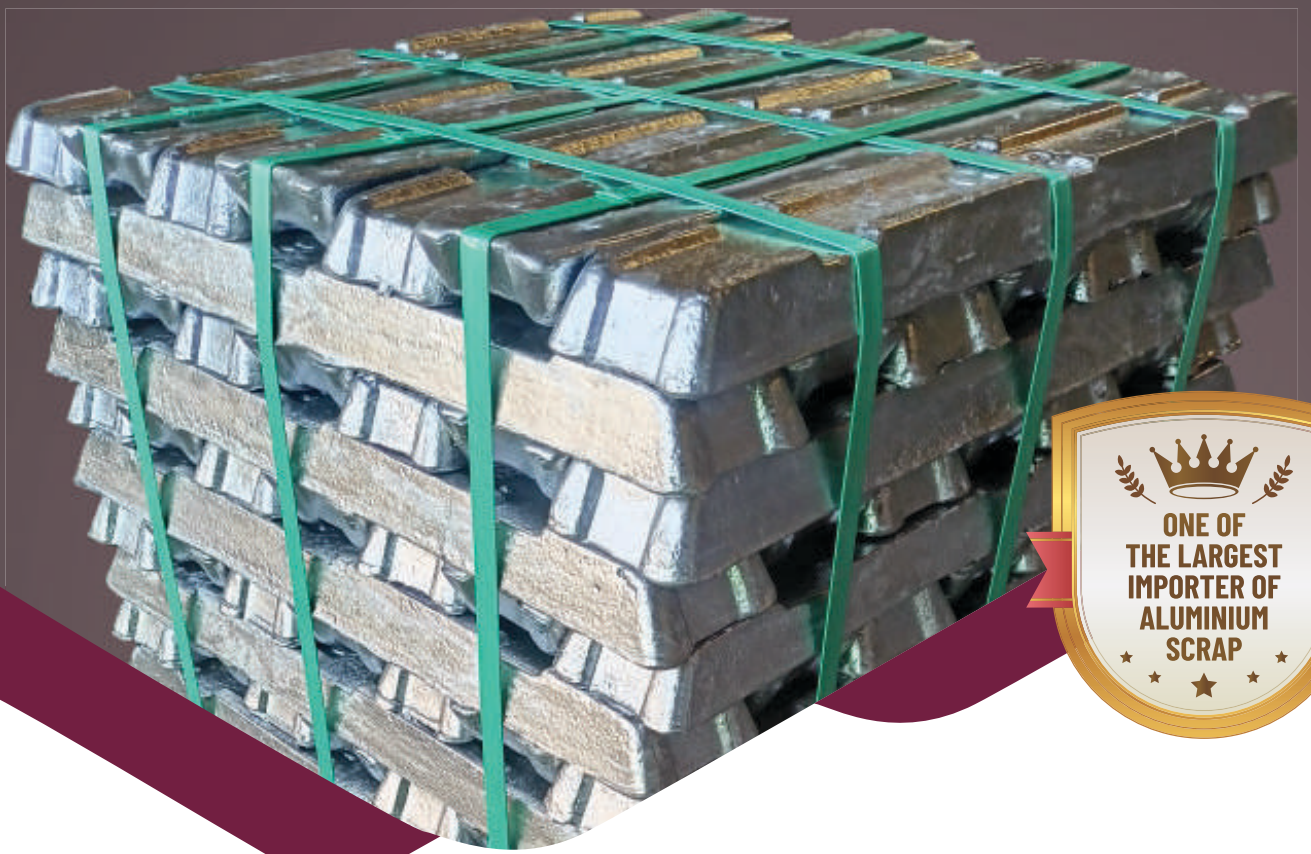

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EDITORIAL

"April is the cruellest month,' what TS Eliot wrote more than a century ago in his classic poem 'The Waste Land' seems to be applicable today. Forget about the scorching heat of summer, the much feared announcement of reciprocal tariffs by the US Trump administration and its latest measure of keeping its implementation in abeyance for some time are still keeping the world and its economies jumpy and jittery.

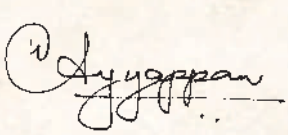
Reciprocal tariffs are often used by countries as a negotiating tactic to pressure other countries into renegotiating trade agreements or addressing trade imbalances. In addition, geopolitical factors continued to influence commodity markets. For example, rising tensions in the Middle East, disruptions in Red Sea shipping routes and Russia-Ukraine war have added volatility to markets and they continue to influence prices and market. The latest EU measures of waste shipments and other regulations have only helped to add to the conundrum.

More than any other industry, recycling as a sector has been at the receiving end, thanks to its emerging nature and wider applicability in comparison with other competing sectors like metals and plastics that use virgin materials and primary routes.

Looking at the way the dynamics of global trade and commerce are shaping up, commodity prices will remain subject to economic policy shifts, geopolitical risks, and changing demand patterns, requiring careful monitoring to assess potential trade implications for all countries. It is especially so for countries like India and other emerging economies which are promising nations where recycling activities are increasingly getting traction.

Tariffs present a strategic opportunity for India to boost its presence in global trading and manufacturing, including recycling. And the Government of the day is geared to that line of action. Let the Best prevail.

Happy Recycling



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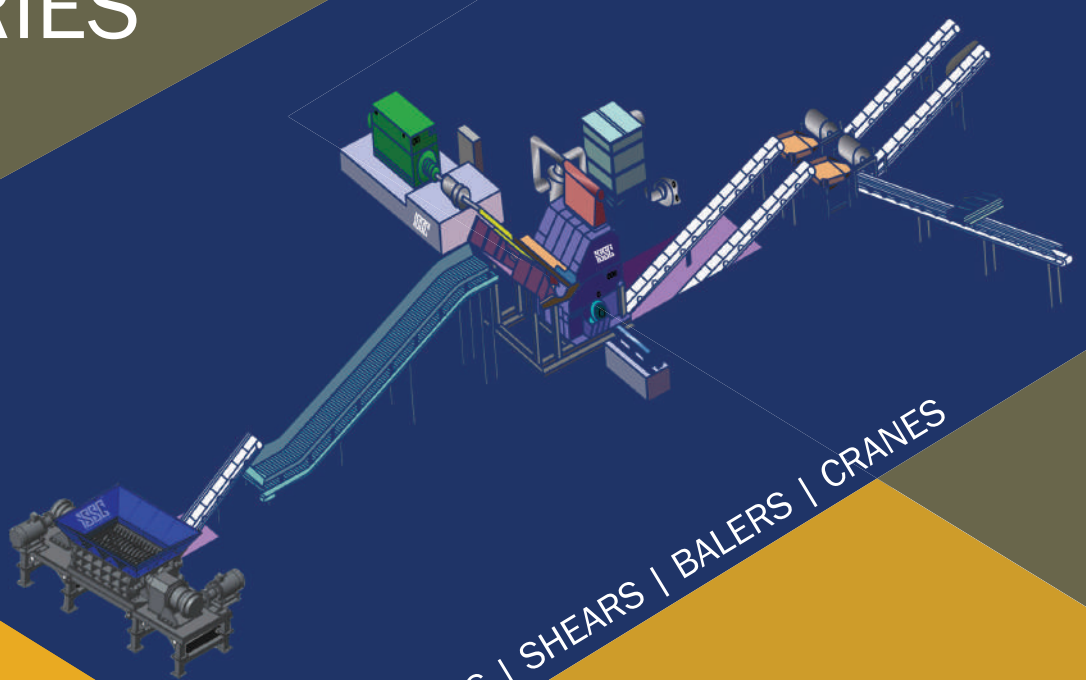

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PLASTIC RECYCLING

Joining the Big League

India's recycling industry has long stood on the brink of transformation—poised for change but awaiting the right momentum. With plastic waste accumulating, environmental policies strengthening, and consumer awareness growing, the push for large-scale adoption of sustainable materials has been building for some time. The introduction of EPR policies in India was the first real push toward large-scale adoption of sustainable materials. By holding companies accountable for the plastic waste, they generate and mandate the use of recycled content in both rigid and flexible packaging, these policies have laid the foundation for a more circular economy.

In a groundbreaking development for the recycling industry, Hindustan Unilever Limited (HUL) has acquired a 14.3% stake in Lucro Plastecycle Private Limited, a company dedicated to driving sustainability and social impact. This milestone is far more than just a business transaction—it is a profound validation of the company's sustainable business model and its unwavering commitment to fostering environmental and social change.

This investment also marks a significant turning point for the recycling sector. It highlights a broader shift towards recognizing the immense potential of the circular economy in India—a model that not only reduces waste but

> The recent strategic investment of HUL in Lucro Plastecycle is symbolic in many ways to India in general and to its plastic recycling community, in particular. **Pratibha Priya Dewett** of Lucro Plastecycle evaluates the development

creates long-term value through reuse and recycling. The announcement has been hailed as a victory for the industry, inspiring optimism and momentum for further innovation and collaboration.

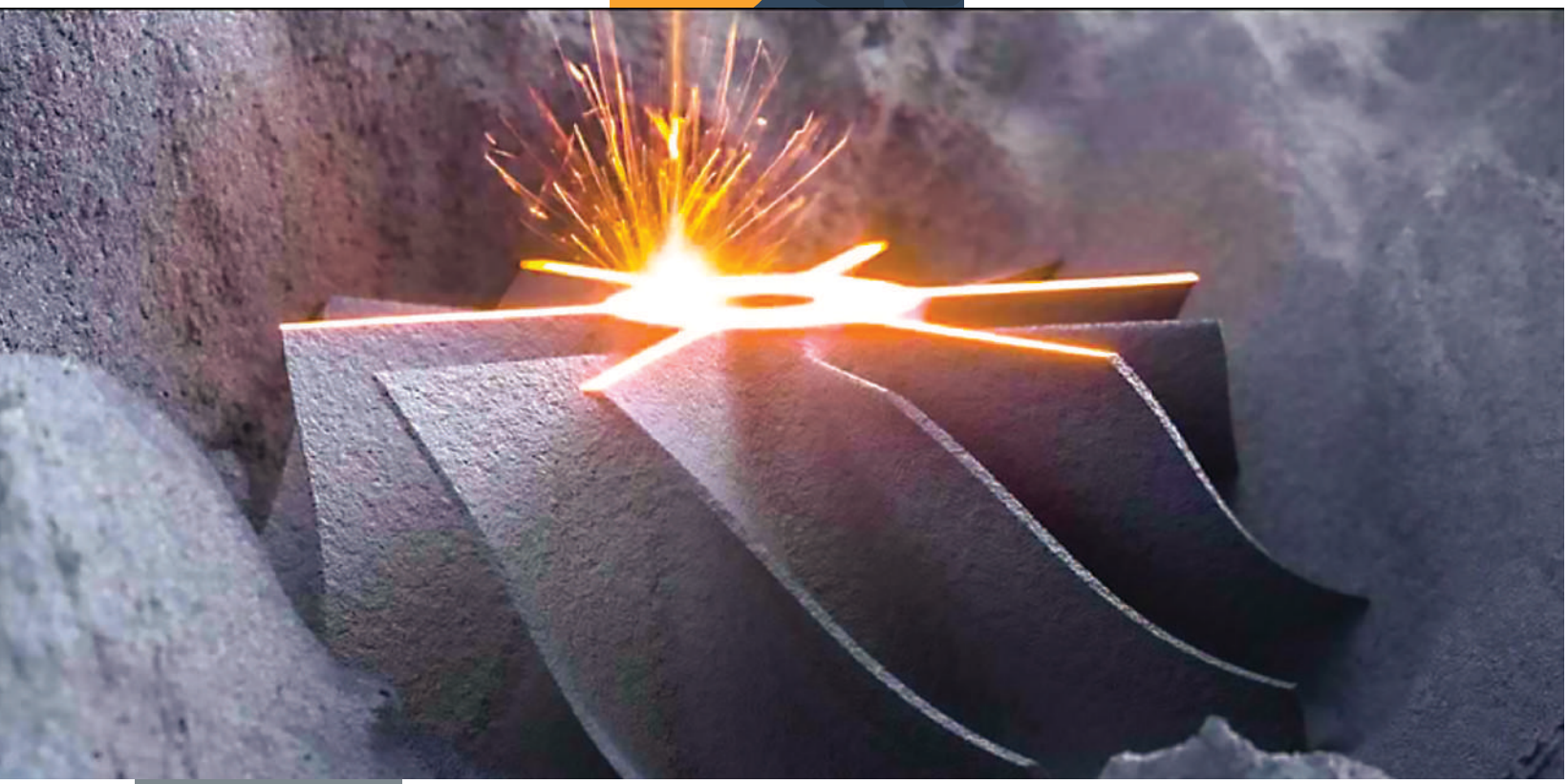
But compliance alone isn't enough to drive real innovation or scale sustainable solutions. What's been missing is a strong market signal—one that shows businesses are not just willing but actively seeking to invest in recycling as a viable, profitable industry. Because at the heart of it, waste management—especially when dealing with post-consumer waste—is a cash-intensive business. Companies in this space are eager to do more, to build better systems, and to create real impact, but to make that happen, access to funding isn't just helpful—it's essential. HUL's investment in Lucro is exactly that signal. It's a turning point for the organization. The organization believes that the fact that circularity isn't just an obligation—it's an opportunity.

Recycling is no longer a niche sector or just an environmental necessity—it is a key driver of Viksit Bharat, contributing to economic growth, job creation, and resource efficiency. A strong recycling ecosystem can strengthen supply chains and formalize the work of nearly 4 million informal waste pickers. It also supports India's net-zero 2070 goals by cutting emissions and keeping cities cleaner. By embracing recycling at scale, India can turn waste into economic value, making circularity a business imperative rather than a regulatory checkbox. HUL's investment in Lucro is a powerful signal of the sector's long-term viability and readiness to scale and innovate.

India generates over 3.5 million tonnes of plastic waste annually. That's approximately 17,50,000 truckloads of material. Yet today, only PET (which makes up a mere 9% of the total mix) is recycled at a large scale. A FICCI report estimates that uncollected plastic waste could cost India over USD 133 billion in lost material value by 2030, with uncollected plastic packaging waste alone accounting for USD 68 billion. HUL's decision to invest is a strong market signal that shows that the private sector is not just responding to regulations but is willing to lead the charge in creating real, lasting change. This is exactly the kind of momentum this industry needs to scale, innovate, and transform waste management into a thriving circular economy.

The next few years will be important as businesses rethink their supply chains and sustainability goals. With continued investment, policy support, and rising consumer awareness, India has the potential to lead globally in sustainable plastics and waste management. But to get there, the industry needs more than mandates—it needs capital, trust, demand, and recognition.

(Ms. Dewett is the Chief Sustainability Officer at Lucro Plastecycle Private Limited)



METAL RECYCLING

The Science and Strategy of 3D Printing

DR IDURY

Analyzing the transformative role of additive manufacturing (AM), and metal powder recycling, **Dr. Satish Idury** highlights how metal production significantly impacts resources and emissions, making recycling vital for sustainability

NECESSITY FOR METAL RECYCLING IN A CIRCULAR ECONOMY

The annual worldwide production of metal alloys totals approximately 2 billion tonnes and consumes 10% of global energy resources. This sector significantly impacts the environment, accounting for 40% of industrial greenhouse gas emissions due to its reliance on carbothermic reductants, fossil fuel-based energy, and feedstock combustion in metallurgical processes. Moreover, primary metal synthesis demands 1.5 times the globally produced metal volume in mineral resources. Residual waste generated throughout the supply chain, from ore mining to processing, exceeds metal production volumes by 15–20 times.

This extensive resource consumption by the metal industry is expected to grow, intensifying climate change and endangering habitats and biodiversity. The sustainability of critical mineral resources for future generations is under threat, necessitating a shift toward a cir-

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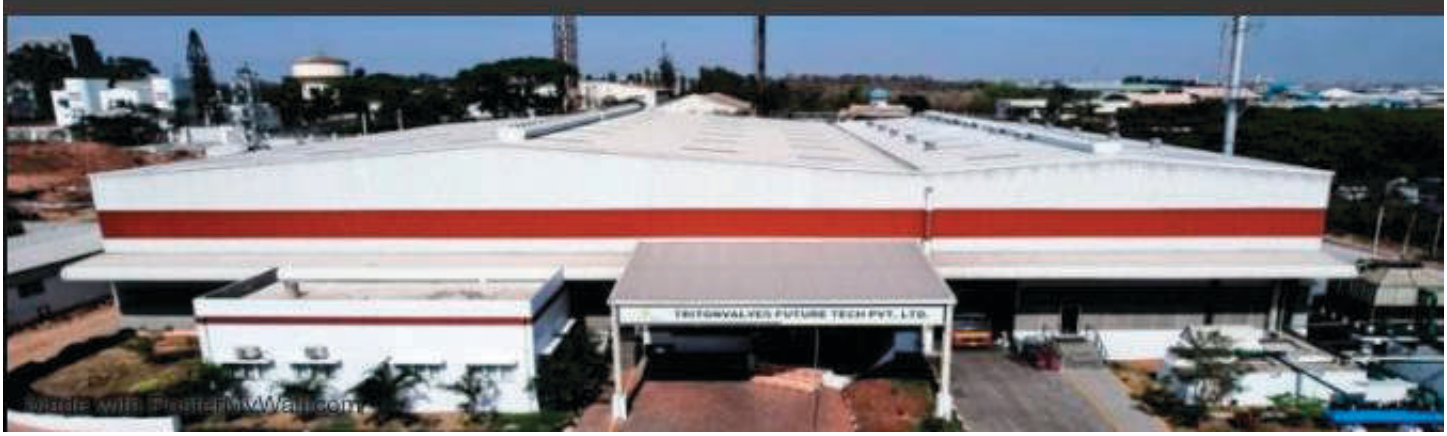


cular economy. Metal recycling offers a sustainable pathway to minimize environmental harm. However, the United Nations Environment Program (UNEP) 2020 report highlights vast disparities in recycling rates. Critical metals like gallium, germanium, and indium have recycling rates below 1%, whereas cobalt and chromium exhibit higher recyclability at 50%, primarily influenced by technological feasibility.

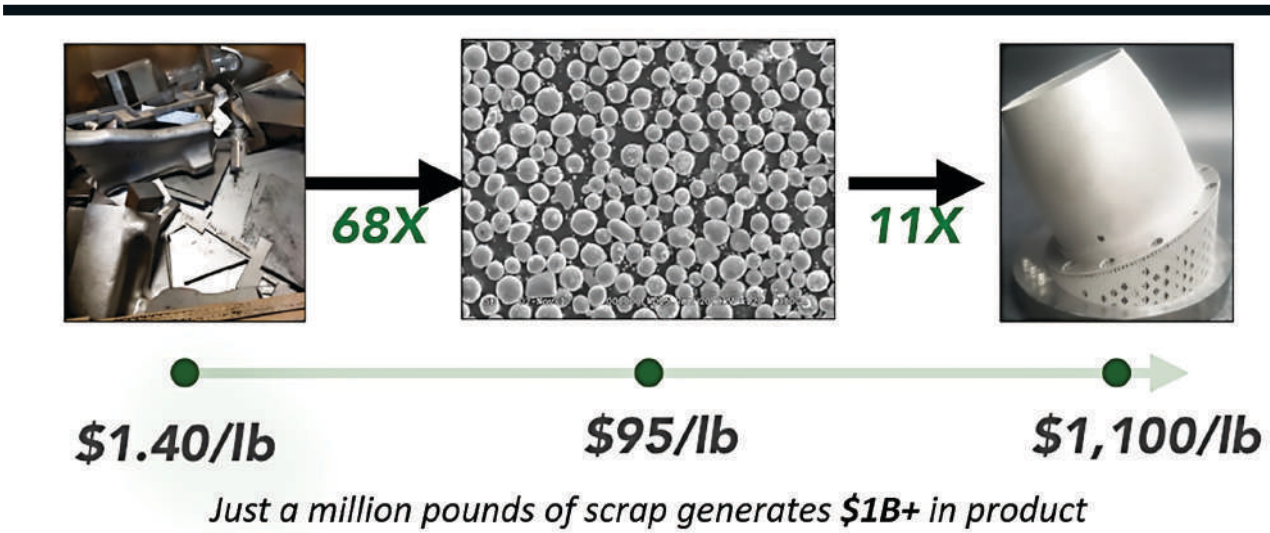
For India, prioritizing recycling efforts for mass-produced structural materials such as steel, aluminum alloys, nickel alloys, and titanium alloys is crucial. These materials ensure economies of scale and mitigate the geopolitical risks associated with importing rare earth and expensive metals like platinum, palladium, and beryllium. Recycling structural alloys also offers significant reductions in greenhouse gas emissions. Collaboration between original downstream equipment manufacturers and primary metal producers can establish an eco-friendly supply chain, supporting sustainable industrial practices and enhancing resource efficiency.

ADVANCEMENTS IN AM 3D PRINTING

AM has revolutionized the production of intricate 3D components in a layer-by-layer fashion through inputs from CAD models. It is particularly effective in production environments that require flexibility and operational efficiency. AM can reduce energy consumption during the fabrication process through optimized toolpath planning. It promotes material conservation by optimizing the topology of the printed component's geometry. This approach also enhances the reuse of engineering components by extending the lifespan of worn or defective products through repair or remanufacturing. Furthermore, it allows for the recycling of precursor materials used in previous printing processes to create new components.

Metal alloy powder contributes to the substantial cost incurred in PBF, and the properties of the printed component depend on the quality of powder feedstock, whether used in pristine condition or reused condition. In the existing metal powder supply chain, various techniques exist for alloy powder production and the resultant quality varies significantly depending upon the technology adopted (Fig.1). While highly sophisticated plasma rotating electrode process can yield high purity powders of spherical morphologies with narrow particle size distribution varying between 0-100 μm; a cheaper technology like water atomisation yields inferior quality powders with irregular morphologies and broad particle size distribution (0-500 μm). The gas atomization (GA) technique is currently the popular method for the synthesis of diverse metal alloy powders with an optimal combination of particle size distribution and morphology. Through prior iterative process parameter optimization, GA allows the production of powders with spherical morphologies, uniform particle size distribution, chemical composition, and better flowability to be used subsequently in a layer-by-layer melting process.

In Powder Bed Fusion (PBF), raw material costs are significantly higher, making powder recycling economical. Studies show recycling can cut costs by up to 92%. Enhancing unconsumed powder recyclability demands a deep understanding of the complex multiscale Multiphysics involved in additive manufacturing (AM) and addressing the challenges inherent in this technique.



MECHANISMS OF DEGRADATION

Powder degradation in Powder Bed Fusion (PBF) is primarily caused by thermal effects, where thermal energy cycling leads to interactions between the energy beam and powder particles. Exceeding the input thermal energy threshold generates spatter from molten droplets and powder particles, which are redeposited onto the powder bed. This alters the alloy powder's chemistry and particle size distribution (PSD), especially at regions of spatter deposition. Enhanced liquid and powder spatter, attributed to transitioning from conduction mode to keyhole-mode melting, creates intense recoil pressure, expelling liquid droplets and powder particles. Spatter morphol-

ogy varies—smooth spherical shapes or irregular agglomerated forms—depending on solidification conditions and dynamic interactions with shielding gas. Entrapped spatter particles degrade the build geometry, absorb oxygen and moisture, and change chemical compositions. Spatter concentration near the melt zone is significant due to latent heat exposure, coarsening powder morphology, and repeated depositions or sintering, affecting powder flowability and spreadability.

Mechanical stresses also degrade metal powders during feedstock handling, bed spreading, densification, compaction, and melting. Frictional stresses from interaction with re-coaters, blades, and powder distribution apparatus cause erosion and wear of additive manufacturing (AM) components. Chemical degradation occurs through reactions with reactive gases, moisture, contaminants from improper handling, and sublimation of low-vapor-pressure elements under intense thermal energy. Powder contamination can arise externally, like in atomization processes where refractory elements erode nozzle walls, entrap gases, or cross-contaminate previous builds.

Feedstock quality for atomization impacts powder composition. Ingots, often fabricated from recycled machining chips, are processed via remelting in arc or induction furnaces or directly through severe plastic deformation. Techniques like hot extrusion—compacting, preheating, and extruding scrap metal, particularly aluminum alloys—address recyclability. Powder metallurgy (PM) methods, including high-energy ball milling and electrolytic decomposition, also recycle machining chips. However, variability in these processes introduces scatter in primary feedstock composition, affecting AM powder quality.

REUSE STRATEGIES IN PBF

Present recycling techniques for Powder Bed Fusion (PBF) metal powders encompass various methods. Mechanical techniques include sieving powders through graded screens and employing centrifugal systems to separate heavier particles from lighter ones. Popular thermal methods like vacuum degassing, remelting, and sintering are also utilized. Vacuum degassing effectively removes contaminants and absorbed gases but alters powder properties. Remelting combines end-of-life powders with fresh metals to restore chemical homogeneity. Electrochemical and acid etching techniques enhance surface properties by removing oxide layers, improving powder rheology. Plasma-based cleaning and spheroidization are emerging approaches that use ionized high-temperature gases to eliminate surface contaminants, trapped gases, and oxidation layers while refining irregular powder morphologies into near-spherical shapes. Plasma treatments extend the usability of powders, achieving comparable properties to virgin powders.

Research on PBF emphasizes three powder reuse strategies: single batch, collective ageing, and replenishment. Each strategy balances powder batch traceability and feedstock wastage. In the single-batch method, powders are recycled only after the initial batch is depleted. This involves sieving residual powders to remove agglomerates and spatter. The collective ageing method mixes powders of similar ageing times, pretreated via separate ageing protocols. The replenishment method blends residual and virgin powders, with replenishment occurring after set build cycles or after every cycle. From an industrial viewpoint, single-batch and collective ageing strategies allow for better correlation between powder history and printed component properties. However, the replenishment method complicates property correlation due to continuous powder mixing.

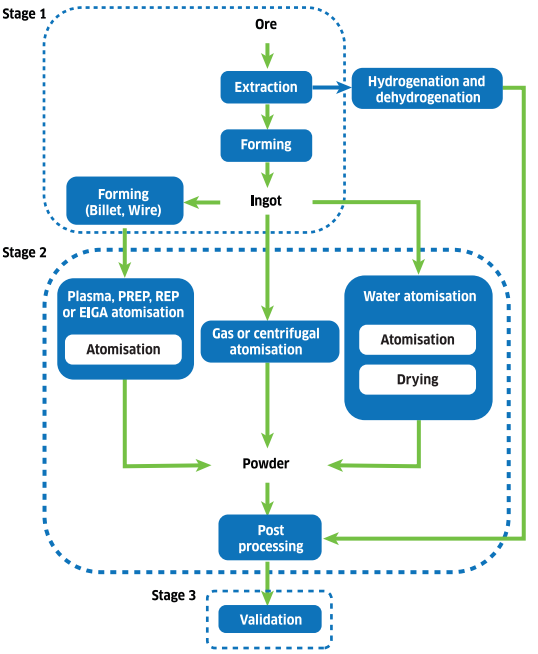


Fig.1: Schematic illustrating various techniques in metal powder production (Johnson Matthey Technology Rev., 2015, 59, (3), 243 DOI: https://doi.org/10.1595/205651315X688686)

> ***Residual waste generated throughout the supply chain, from ore mining to processing, exceeds metal production volumes by 15–20 times***

Comprehensive characterization of reused powders in terms of particle size distribution, chemical composition, and tensile mechanical properties is essential to evaluate reuse strategies. Key research directions include:

1. Develop cost-effective protocols for in situ monitoring of powder attributes during PBF and standardizing reusability testing procedures to lower costs and optimize component properties.
2. Advancing understanding of energy beam and reused powder interactions through simulations and experiments to standardize practices.
3. Innovating efficient powder reconditioning technologies that enhance reusability and integrate seamlessly into industrial processes.

CARBON MARKET

Effective CCS Requires Hybrid Regulation and Fit-for Purpose Framework

MR JARAD DANIELS

While discussing the evolving landscape of Carbon Capture and Storage (CCS), Jarad Daniels, CEO of the Global CCS Institute, highlights how effective CCS deployment hinges on balanced regulation and tailored frameworks to overcome global challenges and drive meaningful climate action

Carbon capture programs have registered serious progress in the last several years globally. How do you describe the progress made?

The momentum for CCS has been steadily increasing over many years. In our 2024 Global Status of CCS Report, we highlighted a 60% year-on-year increase in projects at various stages of development across the CCS value chain. Since the report's release, the Institute's data indicates that this growth has continued, with an additional 15% increase. There are now a total of 65 operational CCS facilities worldwide, with another 650 facilities under construction and development.

What stands out is not just the growth in CCS facilities being developed and deployed but also the diversification of industries where CCS is being applied. We are witnessing a surge in the number of CCS projects in the pipeline for industries such as cement, bioenergy/ethanol, and hydrogen/ammonia/fertilizer—highlighting the significant role of CCS in low-carbon fuel/power generation and products. This breadth of application is creating new opportunities for the transportation and storage of carbon dioxide across national and international borders.

While this progress is encouraging, achieving global climate goals will require annual carbon dioxide capture and storage rates to reach approximately 1 gigatonne per

year by 2030. Currently, the capture capacity of operational CCS projects stands at 57 million tonnes per year, meaning there is still much work to be done.

What are the major challenges in rolling out the programmes across nations?

Several challenges remain in the deployment of CCS. Not all jurisdictions have established the strong and supportive policy and regulatory frameworks necessary to create a robust business case for CCS. More progress is needed on government climate policies and carbon markets to facilitate an investable and scalable CCS business case. At the Institute, we stress the need for robust, supportive policies from governments that provide clear guidelines and incentives for CCS implementation. A comprehensive policy framework should include mechanisms to assign a value on carbon emission reductions, such as through a carbon tax, carbon trading, or tax credits. Additionally, a combination of 'carrots and sticks' is needed to incentivise investment. Without these measures, the private sector will not deploy CCS at the scale required to meet climate change mitigation targets.

> ***Market failures like insufficient incentives or conflicting priorities may impede CCS implementation***

Other challenges include difficult investment settings caused, for example, by political uncertainty and cost increases due to inflation. As countries go through inflationary periods, like the cost increases seen in consumer goods, many large infrastructure projects, including CCS, experience cost increases. Societal considerations also play an important role in the successful deployment of CCS, particularly as public perception and acceptance of CCS can be varied. Engagement with affected stakeholders, including local communities, should be an integral part of all projects from the outset.

How stable and secure are the technologies in use for effective carbon capture?

CCS technologies are both stable and secure, with all stages of the CCS project lifecycle regulated and carefully managed under national and international laws and standards. CCS is also underpinned by technologies that have been available since the 1970s, with decades of experience and data supporting its safety and effectiveness across capture, transport, and storage of carbon dioxide.

In this evolutionary phase, how do you find the nature of regulation, with different countries proposing different parameters? What would you suggest for their homogeneity?

Countries develop CCS policies and regulations tailored to their specific economic, environmental, and political contexts. However, to fully realise the benefits of transboundary CCS value chains, collaboration among countries is essential. To facilitate this collaboration, countries must agree to adhere to international law and protocols and to establish common standards and practices – especially concerning environmental protections, safety, and financial trade incentives.

In recent years, government collaboration on CCS has accelerated. In the Institute's most recent Global Status of CCS Report, we identified over 50 bilateral agreements or MoUs executed by national governments since 2020 that included CCS within their scope. Whilst agreement-making for the transboundary transport of carbon dioxide for geological storage is most advanced in Europe, discussions are also active across the Asia Pacific region and in the Middle East.

At the Institute, we further encourage this level of collaboration through our forums and capacity-building workshops and events, where parties can come together to share knowledge and expertise and engage in meaningful dialogue to identify common challenges and opportunities.

The Global CCS Institute is a leading international think tank with a singular mission: accelerating the global deployment of carbon capture and storage (CCS) technologies. At the core of CCS lies a transformative approach to tackling climate change—capturing carbon dioxide (CO_2) emissions directly from industrial processes or fossil fuel-based power generation. By storing this CO_2 securely underground, CCS prevents its release into the atmosphere. In some applications, it can capture over 90%—and sometimes nearly 100%—of emissions, making it a groundbreaking tool in the quest to reduce greenhouse gas emissions.

To amplify this impact, the CSS brings together its global team to drive adoption through knowledge-sharing, capacity-building, and expert guidance. By enabling cost-effective, efficient CCS implementation, the Institute is empowering industries and nations to address one of humanity's most urgent challenges: achieving a low-carbon future.

Fragmentation across markets and delays in operationalising frameworks are creating uncertainty. What is the timeframe within which you think things will stabilise?

Durable and predictable policy frameworks are crucial for fostering investor confidence and establishing a strong business case for CCS. Currently, the capacity of the CCS facility pipeline, including all projects in operation, under construction, and in development, is 450 Mtpa. However, this amount is significantly less than the gigatonne level of deployment required by the 2030s to achieve our climate goals. Therefore, it is imperative to swiftly develop and implement supportive policies as well as legal and regulatory frameworks.

In the absence of stable and unified legislation, how are the projects faring in execution?

The Institute's data show that countries around the world are driving CCS deployment, overcoming barriers, and advancing large-scale projects to accelerate global CCS deployment. Currently, there are 65 facilities in operation with a capacity to capture and store 57 Mtpa, and there are 42 facilities under construction.

Globally, we see China emerging as a leader in CCS, driving large-scale projects like Huaneng's 1.5 Mtpa coal-fired project and fostering international research collaboration with the likes of France to accelerate industrial decarbonisation.

The UK and Europe are also strengthening the business case for CCS through the refinement of regulatory frameworks, industrial carbon management strategies, and dedicated funding. In Asia, transboundary CCS projects are accelerating, where proponents like Japan continue to drive regional development. Transport and storage networks are emerging in these jurisdictions to serve multiple markets.

In the Middle East, countries like Saudi Arabia and the UAE are positioning themselves as leaders in CCS by establishing large-scale carbon hubs and advancing transboundary projects. Notable initiatives include Saudi Aramco's goal to expand CCS capacity at Jubail and ADNOC's development of a CCS network in the UAE.

What do you think of CO2 - a waste or a commodity? What is the perspective of your institute?

While carbon dioxide is a waste product of combustion and a significant contributor to climate change when released into the atmosphere, it can also be considered a valuable commodity for some applications. It serves as an input for products like fertilisers and can be converted into various chemicals and building materials.

> ***The growth of CCS facilities is driving low-carbon innovations across industries like cement, bioenergy, and hydrogen***

Whether carbon dioxide is classified as a waste or a commodity does have implications for policy and regulatory frameworks for CCS. Viewing carbon dioxide as a commodity could facilitate the growth of the CCS market, aid in price discovery, and provide liquidity for infrastructure development in a more efficient way. Conversely, treating carbon dioxide as waste may lead to stricter requirements on energy and hard-to-abate industries, effectively adding CCS to the cost of doing business.

The success of CCS hinges on a balance between regulation and market-driven solutions. According to you, should the market be allowed to grow organically before being subjected to rigid regulation?

To deploy CCS effectively, a "fit-for-purpose" regulatory framework is essential. This framework should address CCS hubs, clusters, and cross-border transport, ensuring safe and efficient carbon dioxide storage and transportation.

On one hand, allowing the market to grow organically can foster innovation and competition, potentially leading to more efficient and cost-effective solutions. On the other hand, slow regulatory development could lead to inefficiencies and potential environmental or safety risks if not managed properly. There is also the risk of market failures, such as inadequate financial incentives or competing priorities, which could hinder the large-scale implementation of CCS. Therefore, a hybrid approach could be more effective, facilitating some organic market growth while introducing thoughtful, flexible regulation early in the process.

How important is the Paris Agreement for evolving the carbon market mechanisms?

The Paris Agreement plays a crucial role in the development of carbon market mechanisms, with Article 6 serving as a foundational element for their implementation.

Under Article 6, two core mechanisms are now in place - the bilateral trading of Internationally Transferred Mitigation Outcomes (ITMOs) and the Paris Agreement Crediting Mechanism (PACM). ITMOs enable countries to meet their Nationally Determined Contributions (NDCs) while incentivising investment in emissions reduction and removal technologies like CCS. The PACM supports the international sale of carbon credits generated by projects, helping offset deployment costs associated with CCS. This system integrates carbon capture and removal efforts into global climate accounting frameworks, ensuring transparency as well as boosting the financial viability of these technologies.

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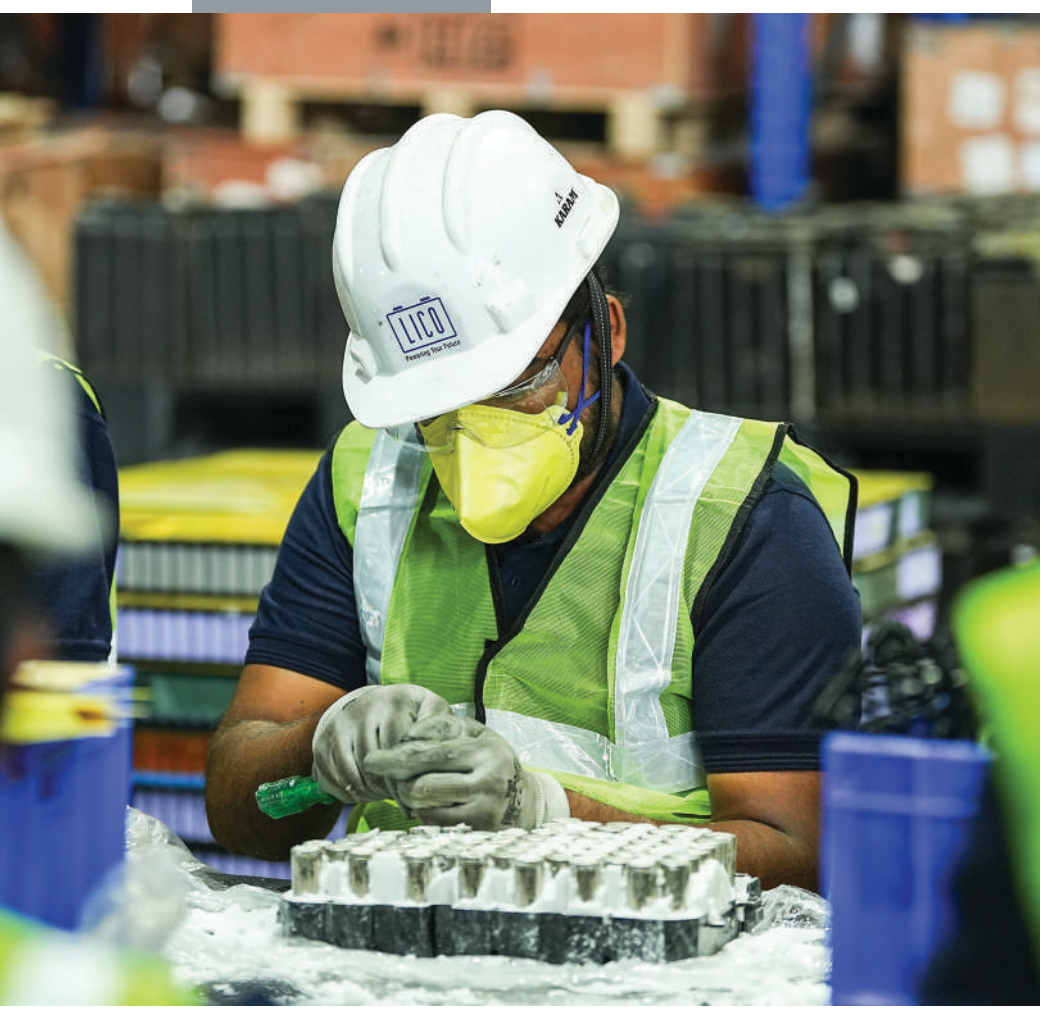
LITHIUM BATTERY RECYCLING

Staying Aligned with Circularity

MR. DOLWANI

Exporting black mass should not be seen as a long-term solution but rather as a strategic bridge, writes Gaurav Dolwani of **Gaurav Dolwani** as he explains how it would help India buy time to build domestic refining capacity



As India commits to achieving net-zero emissions by 2070, the nation stands at a pivotal crossroads. The journey toward sustainability is both a critical environmental obligation and a significant economic opportunity. Yet, navigating this path is far from simple—it demands systemic change, innovation, and regulatory vigilance.

THE ELECTRIC VEHICLE REVOLUTION

India has set an ambitious goal to have 30% of electric vehicles in the sale of passenger vehicles by 2030. This transition could prevent up to 25 million tonnes of CO_2 emissions annually. With the EV market projected to surge from USD 3.21 billion in 2022 to USD 114 billion by 2029, the momentum is strong. However, this transformation involves more than just swapping fuel tanks for batteries. It requires sustainable systems to manage EV waste—especially batteries- throughout their entire lifecycle.

A MODEL RESOURCE MANAGEMENT

Unlike the traditional linear model of "take, make, dispose," circular supply chains are designed to retain resources within the economic loop for as long as possible. This is particularly important for the EV sector, where batteries contain critical materials like lithium, cobalt, nickel, and graphite.

Recycling is central to this system. After approximately three to eight years of use, EV batteries typically reach the end of their first life cycle. At this point, recyclers recover critical minerals, generating a substance known as black mass, which can be processed to extract reusable materials. However,

without effective recycling infrastructure, India's estimated 15 million EVs on the road could become both an environmental threat and a squandered economic opportunity.

To address this, the government has introduced the Extended Producer Responsibility (EPR) policy, which makes manufacturers accountable for the full lifecycle of their batteries.

POLICY WITH PITFALLS

Under the EPR framework, battery producers must ensure the responsible disposal or recycling of used batteries. Recyclers issue EPR certificates to validate proper processing, and these certificates become a prerequisite for producing new batteries. Yet, despite good intentions, serious implementation flaws have emerged. Discrepancies exist between the actual domestic demand for minerals and the volume of EPR certificates issued.

To overcome such issues, a robust audit mechanism must be established to ensure that EPR credits genuinely drive profitability for recyclers rather than merely facilitating paper-based trading. Reported recycling efficiencies of 98–99% and recovery rates far exceeding China's benchmark of approximately 90% are particularly concerning—especially given that China, with over a decade's technological lead and more than 100 times India's recycling capacity, sets a more realistic standard.

These irregularities suggest a troubling trend: the fabrication and trade of EPR certificates without corresponding recycling activities. This practice undermines the core intent of the policy, puts compliant businesses at a disadvantage, harms the environment, diverts critical minerals into the informal sector, and promotes cash-based transactions—running counter to the country's goal of fostering a digital economy.

STRENGTHENING DOMESTIC SUPPLY CHAIN

India currently lacks the commercial-scale infrastructure required to refine black mass into battery-grade minerals. Meanwhile, countries like China, Japan, and South Korea possess advanced hydrometallurgical facilities capable of high-purity extraction.

In this context, exporting black mass emerges as a pragmatic interim measure. It allows legitimate recyclers to process materials in countries with existing capabilities, prevents fraudulent EPR practices, and ensures valuable minerals re-enter the global circular economy.

Exporting black mass should not be seen as a long-term solution but rather as a strategic bridge. It buys India time to build domestic refining capacity while staying aligned with circular economy principles and maintaining environmental integrity.

Some recyclers claim to be extracting battery-grade material from black mass, but without domestic p-CAM, anode, and cathode manufacturers, this material is likely to be exported—undermining the goal of retaining critical minerals within the country. To truly achieve this objective, the focus must shift toward building a complete domestic supply chain, improving process efficiency, reducing costs, and enhancing product quality. Export bans, however, could trigger global consequences, as evidenced by the current international trend toward tariffs and trade restrictions, which challenge the principles of free trade and ease of doing business.

> ***Without effective recycling infrastructure, India's estimated 15 million EVs present both threats and opportunities for the environment***

WHAT'S NEXT

India's transition to a net-zero future hinges on the credibility and effectiveness of its sustainability frameworks. The EV revolution presents a once-in-a-generation opportunity—but only if supported by genuine, functional circular systems.

To realize this potential, India must confront the limitations in its current EPR implementation and enforce regulatory compliance. By doing so, the country can avoid shifting environmental burdens and instead lay the groundwork for a resilient, self-sustaining green economy—one that protects the planet while fueling long-term economic growth.

(Mr. Dolwani is the CEO and founder of Lico Materials).

PLASTIC POLLUTION

Global Problem Local Solution

Effective addressal of plastic waste demands a comprehensive campaign to enhance societal awareness, encourage recycling practices, instill a sense of personal responsibility, and advocate for the adoption of biodegradable packaging alternatives, writes **Commodore Sujeet Samaddar**

Plastic, though revolutionary for its durability and affordability, has led to a crisis. A staggering 20 companies produce 55% of the 400 million tonnes of plastic waste generated annually. Sadly, only 9% is recycled, while the remainder is incinerated, landfilled, or pollutes ecosystems. Rivers transport much of this waste into oceans, where it disrupts marine life and enters the food chain, affecting human health.

The adverse effects of plastic pollution extend to both land and oceans, posing a threat to global ecosystems and human well-being. Tackling this issue demands responsible consumption, enhanced recycling practices, societal awareness, and the promotion of biodegradable alternatives. Plastic Odyssey demonstrated that innovative solutions and collective effort can lead us towards a sustainable future.

The Plastic Odyssey concluded its 33rd edition in Chennai from March 1st to March 22nd, 2025. Simon Bernard,

COMMODORE SUJEET SAMADDAR

President of Plastic Odyssey, leads an ambitious global initiative to combat marine plastic pollution. "Plastic Odyssey is a groundbreaking three-year sailing expedition supported by Maison L'Occitane en Provence. The 40-meter expedition vessel, which doubles as a floating experimental laboratory, set sail from Marseille in October 2022."

The Material Recycling Association of India (MRAI) hosted the Plastic Odyssey team at the Courtyard Marriott Chennai on 18 March 2025 for the workshop "Value Chain of Marine Plastic Waste Recycling." The event focused on the urgent issue of marine plastic waste recycling, engaging participants, including 20 cadets and faculty from the Indian Maritime University and Indian Navy officers attending for the first time. The Navy's remarkable efforts in marine plastic pollution control were also discussed.

Sponsored by Pondy Oxides and Chemicals Limited (POCL), the workshop began with welcome remarks from Mr. Bansal, followed by an insightful presentation by Mr. Simon Bernard, CEO of Plastic Odyssey. A documentary highlighted the team's innovative recycling ventures, transforming plastic waste into sustainable products. The organizing team and the delegates visited the ship that was equipped with innovative recycling technologies that convert plastic waste into building materials, tiles, furniture, and energy sources.

Guest of Honor Dr. P.J. Rangachari emphasized the essential role of marine engineers in developing sustainable business models to address marine plastic pollution. Commodore Suvrat Magon discussed the Navy's environmental stewardship initiatives, while Mr. B. Swaminathan shared practices in plastic recycling in Chennai.

On 19 March 2025, the EU-India Resource Efficiency and Circular Economy Initiative held a workshop at Hyatt, Chennai. Representatives from diverse sectors discussed crucial issues like the World Bank's strategies to tackle plastic pollution, ghost nets (ALDFG), ECONYL's recycled nylon, and microplastic mitigation. These sessions underscored the necessity for innovative and collective solutions to combat marine plastic pollution. The session covered various topics, focusing on the Extended Producer Responsibility (EPR) regimes introduced by the Government. Concerns were raised about EPR policies reducing producer responsibility to mere legal compliance while excluding informal waste workers from the benefits of EPR certificate trading. Speakers emphasized redistributing profits across the value chain and involving consumers in pollution mitigation efforts.

Ashish Bansal, MD, POCL speaking during a Workshop on Value Chain of Marine Plastic Waste Recycling in Chennai

Kumuda, a representative of waste pickers, delivered an inspiring talk, stressing their essential role in recycling and advocating for fair recognition and remuneration. She shared her aspirations for waste pickers to lead dignified lives. Challenges around multilayer plastics, requiring specific sorting methods and often ending up in cement factories or landfills, were also discussed.

While concluding hte session, the Ambassador of EU to India and other officials stressed the urgency of tackling plastic pollutionOne key achievement of Plastic Odyssey is the launch of its first containerized, decentralized recycling unit factory in the Philippines, with immense potential to address plastic waste in India. By recycling plastic waste at the point of collection, this system tackles pollution at its source while creating valuable products.

(Commodore Sujeet Samaddar, NM is a (Retd) Adviser with MRAI)

RE-REFINING FOR CIRCULARITY

MS NAIK

While major producers of oils and lubricants focus on tie-ups with recyclers or captive collection networks, smaller players rely on open-market certificate purchases, fulfilling compliance through various EPR models, writes **Ms. Priya Naik** of Enviro Oil Savers Association (EOSA)

Imagine you are at a car service station, watching as your car's engine oil is taken out and drained in a container. Ever wondered what happens to that oil? Well, that is used oil—an often-overlooked resource with immense potential. Used oil may appear to be just another industrial by-product, but it is a valuable resource with immense potential. It comes from engine oil, gear oil, hydraulic oil, and even transformer oil—any oil derived from crude or synthetic blends. If left unmanaged, it can be a serious environmental hazard. However, with the right re-refining technologies, it can be transformed back into high-quality oil, meeting all quality standards set by the government and ready to be used in the system.

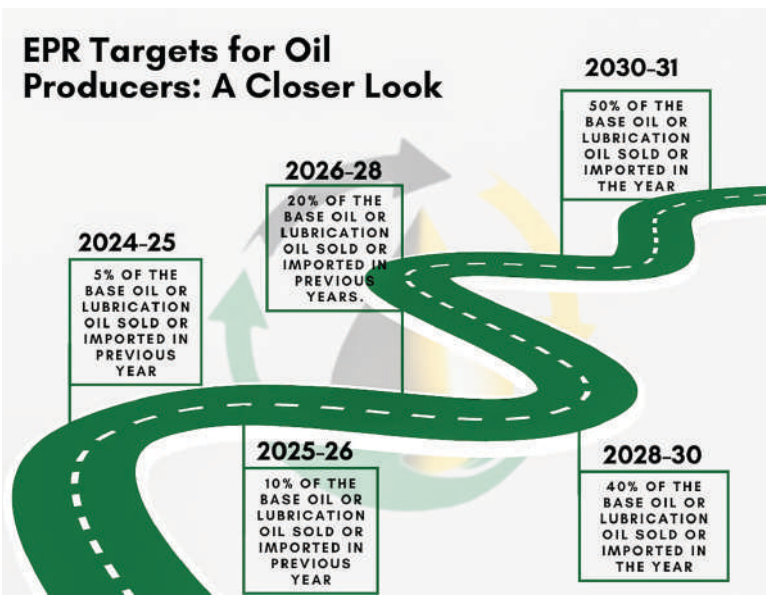
UNDERSTANDING THE MANDATE

Recognizing the potential for achieving a circular economy in the oil and lubricants sector, the Government of India introduced the Extended Producer Responsibility (EPR) framework for used oil under the Hazardous Waste Management (Second Amendment) Rules, 2023.

This amendment came into effect in April 2024. It mandates that oil producers, importers, and used oil importers take responsibility for collecting and re-refining Used Oil, aiming to close the industry's loop. In the future, manufacturers will also have the mandate of using re-refined base oil in the production of new lubricants to reduce dependence on virgin oil, thereby creating a closed-loop system. Let's explore how developments are shaping the re-refining sector with rising producer targets and increasing environmental awareness.

ACHIEVING CIRCULARITY

Do you know that the energy required to manufacture re-refined base oil (RRBO) from used oil is only one-third of the energy required to refine crude oil to produce virgin base oil? Modern re-refining technologies can produce RRBO that meets the quality specifications of Group I, Group II, and even Group III base oils, depending on the process used. Used oil can be recycled through many techniques, such as acid clay treatment, vacuum distillation, hydrotreating, solvent extraction, or combination techniques. The re-refined base oil that comes out of the process can be utilized in the production of a lubrication oil. Thus, recyclers play a



(Source: Enviro Oil Savers Association)

crucial role in advancing the nation's Circular Economy goals, and this can be achieved through four key areas, integrating the EPR mandate:

MEETING COMPLIANCE STANDARDS

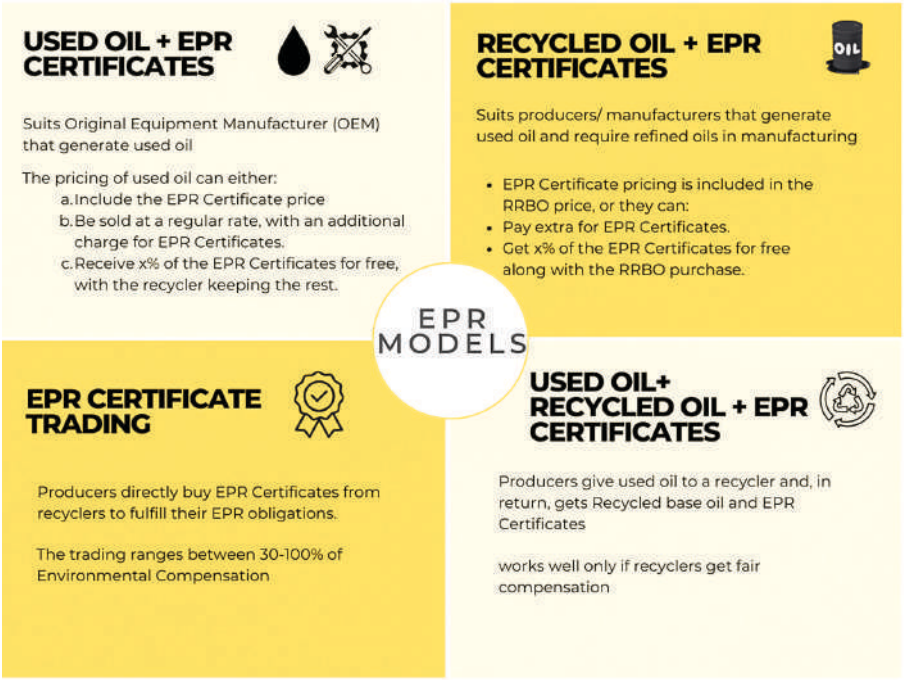
The Used Oil EPR framework mandates producers and importers of base oil and lubricants to ensure the recycling of Used Oil. In 2024-25, companies must recycle 5% of the oil sold in 2022-23, increasing this to 50% by 2030-31. To meet these targets, producers must purchase EPR Certificates from re-refiners, issued upon submission of Proof of Execution (POE). On the CPCB EPR portal, re-refiners are required to upload both the invoice for the used oil procured and the invoice for the re-refined base oil sold. Based on the technology used, a specific conversion factor is applied to determine the quantity of eligible recycled oil.

While large producers are exploring long-term tie-ups with recyclers or investing in captive collection networks, smaller players often rely on open-market certificate purchases. Thus, compliance can be fulfilled via one of the following EPR models, as depicted in the image.

With an estimated 0.85–1 MMT EPR Certificate requirement by FY 31, its vital to have a re-refining capacity of 600–700KT. To ensure adequate supply, EOSA organization is working on bridging the gap between producers and recyclers, building a strong industry network, and ensuring the reliability of EPR Certificates—critical, as rising demand and fragmented strategies may lead to a shortage, making collaboration and stakeholder commitment more essential than ever.

TECHNOLOGY AND INFRASTRUCTURE UPGRADES

EPR highlights the growing importance of re-refiners in making oil production more sustainable. Without recycling, used oil can harm the environment, but through proper re-refining, it can be turned into high-quality oil again, reducing the need for fresh crude oil. Therefore, it is important to direct investment towards the technology upgradation for used oil processing and testing facilities to make sure that re-refined base oil meets the Bureau of Indian Standards (BIS) specifications as set by the Government. Due to a lack of robust testing facilities and advanced re-refining technologies, the scalability and quality of the product gets hampered. Investment in advanced re-refining technologies will likely grow with stricter government enforcement in the EPR framework and initiatives from organizations like EOSA. Furthermore, collection agents are vital to the supply chain, and formalizing the existing informal collection agent's network will require targeted funding and support.



EFFECTIVE AWARENESS IS KEY

Continuous workshops, webinars, and training programs help stakeholders stay informed on EPR compliance and ensure their active participation. EOSA has introduced Information, Education, and Communication (IEC) programs to shift stakeholders' belief systems, facilitating smoother EPR implementation, especially for OEMs and Oil Producers.

TOWARDS A NATIONAL ASSOCIATION

A national-level association plays a vital role in standardizing, overseeing, and streamlining used oil collection, recycling, and the integration of RRBO in manufacturing. To further structure and unify the industry, EOSA, as a non-profit, qualifies as a leading National Used Oil Management Association to:

- Organize collection, transportation, storage, testing, and recycling of used oil
- Create a collection centre consortium among re-refiners, producers, and collection agents
- Encourage investment in advanced re-refining technologies

This initiative will be pivotal in aligning India's used oil management with global best practices while ensuring regulatory compliance.

THE WAY FORWARD

The implementation of EPR marks a major step toward a circular economy in India. While compliance demands investment in technology and logistics, it also unlocks growth opportunities for re-refiners through structured collection systems and regulatory support.

With EOSA driving industry awareness, compliance support, and policy advocacy, stakeholders can smoothly transition to the new framework. The formation of the National Used Oil Management Association will further enhance transparency and efficiency in the sector. EOSA invites organizations on this journey toward a sustainable future for used oil recycling in India.

(Ms. Naik is the Director of Enviro Oil Savers Association (EOSA).)

PLASTIC RECYCLING

'At the Forefront of Sustainable Packaging'

Suhail Mohammad of Athar Packaging Solutions aims to bridge the gap between environmental stewardship and market demands by developing scalable solutions for a greener future

What motivated you to launch Athar Packaging Solutions, and how did you identify a gap in the recycling industry that you were uniquely positioned to fill?

The motivation to launch Athar Packaging Solutions came during the COVID-19 lockdown. While most people were confined to their homes, I noticed that waste, especially plastic, continued to pile up. One day, during a short 10-minute trip to city, I was shocked to see heaps of plastic waste dumped near residential areas. This sight triggered deep concern and a strong desire to act.

As I researched more, I found that 20-25% of industrial plastic waste is generated during the manufacturing process itself and which often ends up in landfills or rivers. This was a lesser known yet massive gap. Unlike post-consumer waste, this pre-consumer industrial waste was not being addressed effectively.

With a background in operations and sustainability, I realized I was well-positioned to act. I envisioned a model where this neglected industrial waste could be upcycled into premium packaging products, serving a dual purpose: solving an environmental issue and meeting market demand. this vision was one of the key drivers in building the foundation of our company.

Your work has gained recognition for its unique approach to recycling. Could you share the innovative techniques or materials that distinguish your solutions from others in the industry?

Athar Packaging Solutions stands out due to its groundbreaking innovations in material treatment and segregation. One key achievement is the mastery of the segregation process, allowing the effective separation of single-layer and multi-layer polyester plastics—a significant challenge for the industry. This precision ensures that each layer is reused efficiently, eliminating the risk of contamination.

Another major innovation lies in the company's eco-friendly lamination process. Departing from traditional chemical adhesives, Athar Packaging Solutions developed a sustainable adhesive derived from fruit waste. This adhesive enables the lamination of paper with plastic and the bonding of multiple polyester layers. The result is durable and recyclable packaging that avoids environmental harm. This approach not only reduces reliance on synthetic materials but also adds biodegradable value to the packaging lifecycle.

You recently managed to recycle 300+ tonnes of plastic annually. What were the key strategies that led to this success?

Our success in recycling 300+ tonnes of plastic annually was driven by four key strategies:

- **Strengthening Supply & Demand:** We built strong partnerships with plastic industries, convincing them to provide their waste and allow segregation at the source. Simultaneously, we targeted organizations committed to SDG and ESG goals to build a steady, value-aligned customer base.
- **Localized Waste Collection:** We set up decentralized waste collection systems to minimize logistics, reduce carbon footprints, and ensure a consistent raw material supply.
- **Market-Aligned Product Design:** We focused on high-demand products like zipper pouches and stand-up pouches, as plastic pouches dominate 30% of the packaging market.
- **Mission-Driven Sales Approach:** Every sale is led with purpose. Our team communicates not just the product benefits but also the environmental impact of choosing Athar, making each customer a sustainability partner.

Are there cutting-edge technologies you've integrated into your processes that are reshaping the way plastic recycling is approached in your organization?

At Athar Packaging Solutions, we have adopted cutting-edge technologies that transform the landscape of plastic recycling and sustainable packaging. One of our key innovations is eliminating the initial production stages of plastic. By utilizing waste plastic, we effectively bypass the first three stages of virgin plastic production, which results in significant reductions in carbon emissions.

Our semi-automated processing systems represent another leap forward. These systems are designed to enhance efficiency, reduce energy consumption, and maintain high-quality outputs, making scalability and consistency achievable across our operations.

Additionally, we have innovated the use of fruit-waste-based adhesives, offering a biodegradable and eco-friendly alternative to traditional chemical adhesives. This advancement minimizes environmental impact while ensuring strong and durable packaging solutions.

Together, these innovations place Athar Packaging Solutions at the forefront of sustainable practices, driving global efforts to reduce plastic waste and carbon emissions while revolutionizing the packaging industry.

> ***We are also expanding our product lines by developing packaging solutions derived from agricultural waste***

What was the most significant challenge you've faced on this journey, and how did you overcome it?

One of the most significant challenges we faced at Athar Packaging Solutions was securing a consistent supply of industrial plastic waste. Initially, we relied on two suppliers, but when they abruptly ceased deliveries, we were unable to fulfill substantial customer orders. Recognizing the urgency, we paused new orders and dedicated two months solely to expanding our supplier network. Understanding that industrial plastic waste is a pain point for many companies, we successfully onboarded 16 additional suppliers during this period. To further strengthen our supply chain, we introduced a referral programme, rewarding existing suppliers for introducing new ones. This initiative expanded our network to over 22 suppliers, ensuring a robust and reliable supply chain.

This experience underscored the importance of a resilient supply network, enabling us to meet growing demand and advance our mission of sustainable packaging.

What's next for Athar Packaging Solutions? Are there any new markets, products, or technologies you're excited to explore to expand your impact and growth?

Looking ahead, Athar Packaging Solutions has an ambitious roadmap to drive sustainability and innovation further. One of the key focuses is advancing biodegradability. Currently, 37.4% of packaging decomposes within 180 days, but with R&D investments, the goal is to achieve 100% biodegradability within three years. This milestone will significantly enhance environmental impact and align with global sustainability goals.

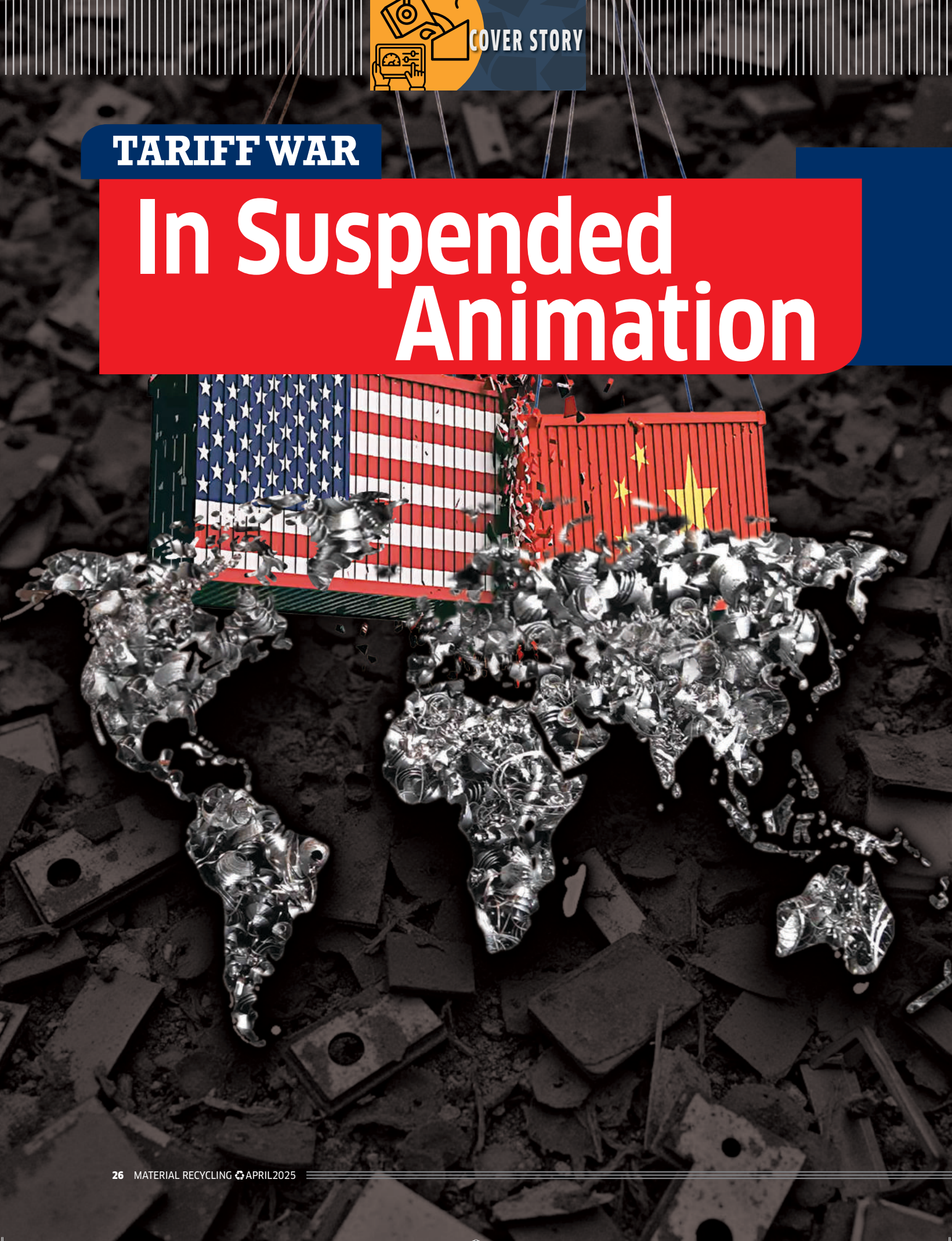
We are also expanding our product lines by developing packaging solutions derived from agricultural waste. These eco-friendly alternatives not only support the agricultural sector but also provide sustainable options for the market. In addition, customized packaging options are being introduced for large corporations, meeting specific needs while promoting sustainable practices.

In terms of scaling impact, the company aims to onboard 5,000 companies and recycle 10,000 tonnes of plastic annually by 2027. This initiative is expected to reduce CO_2 emissions by approximately 30,000 metric tonnes per year and save around 57.7 million kilowatt-hours of energy annually.

These strategic initiatives place Athar Packaging Solutions at the forefront of sustainable packaging, driving environmental benefits and providing scalable solutions for a greener future.

TARIFF WAR

In Suspended Animation



In one of the drastic actions of the Trump Government, the US saw the implementation of reciprocal tariffs on 50-odd nations that trade with the country, with disastrous consequences. Here is a recount of the developments after the pause that the President has applied to implementing the draconian measure. Besides, some leading analysts and industry stakeholders opine their takes on the issue.

The world economy is still reeling under the shock and turmoil of the financial meltdown following the tariff burden that the US President Donald Trump imposed on the country's 50 + trading partners in early April. Even though he has paused the implementation of the draconian legislation for some time, countries are still busy trying to figure out how to navigate their economies unscathed from the disastrous consequences if such protectionist policies are made operational.

Tariff hikes on China, Taiwan, the EU, and India

Historically, the world's manufacturing leader, China, faces a 34% reciprocal tariff in addition to the existing 20% tariff tied to issues like fentanyl trafficking, bringing the total tariff rate to 54%. The tariff was later hiked to 125% on April 9, 2025. In retaliation, China imposed a 34% duty on US products.

The president then announced a 90-day pause in implementing the rates on other countries, except China. It was seemingly an attempt to narrow what had been an unprecedented trade war between the U.S. and most of the world to a showdown between the U.S. and China.

While Taiwan was hit with a 32% reciprocal tariff, most manufactured goods from Taiwan still face a steep levy, affecting its competitiveness despite exceptions for semiconductor investments.

The European Union (EU) is subject to a 20% reciprocal tariff. Although this rate is lower than in China and Taiwan, it still raises costs for EU-manufactured goods, particularly in sectors like automobiles and machinery, where countries like Germany and Slovakia are key players.

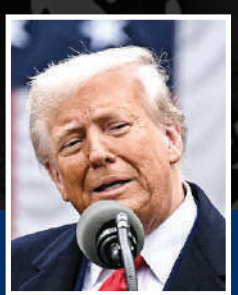
India faces a 26% reciprocal tariff, comparatively lower than China (54%), Taiwan (32%), and even Vietnam (46%), another manufacturing hub, though higher than the EU's 20%. This 26% tariff, while not negligible, positions India favourably compared to China and Taiwan, and even Vietnam.

Additionally, all countries face a universal 10% baseline tariff on imports to the U.S., which stacks onto these reciprocal rates.

Reciprocal tariffs as a trade policy have become more common in recent years, especially during the previous term of President Donald Trump's administration, which saw a series of tariff actions aimed at correcting trade imbalances and addressing unfair trade practices.

A key example of reciprocal tariffs happened during the U.S.-China trade war that intensified in 2018. The U.S. placed tariffs on many Chinese products, claiming unfair trade practices and intellectual property theft. In response, China imposed tariffs on American goods, including agricultural items like soybeans and pork. This cycle of tariffs increased costs for consumers and businesses in both nations.

India, in response, has also taken reciprocal tariff actions against the United States. After the U.S raised tariffs on steel and aluminum imports from India, India responded by increasing tariffs on several American goods, including al-



For decades, our country has been looted, pillaged, raped and plundered by nations near and far, both friend and foe alike.

DONALD TRUMP
US President

DR SHUNMUGHAM

'TARIFFS WILL INTRODUCE SIGNIFICANT CHALLENGES TO THE GLOBAL RECYCLING TRADE'

Commodity market veteran* Dr Shunmugham *feels that recycling sector's intricate international dependencies mean that such measures could inadvertently hinder recycling rates and sustainability goals globally.

President Donald Trump's "Liberation Day" trade tariffs, which were announced to impose up to 49% duties on imports from countries like Cambodia and Vietnam, are poised to significantly impact the global recycling industry. This sector, valued at approximately $62.22 billion in 2024 and projected to reach $78.43 billion by 2028 with a compound annual growth rate (CAGR) of 6%, relies heavily on international trade for the movement of recyclable materials.

A substantial portion of recyclable materials, particularly plastics and paper, are exported to Southeast Asian nations for processing. For instance, China and India have been leading importers, with China alone contributing over 50% to the global plastic recycling market. The imposition of high tariffs on imports from these regions could disrupt established supply chains, leading to increased operational costs for recycling companies and potential bottlenecks in processing capacities.

The plastic recycling segment, valued at $32.9 billion in 2023 and anticipated to grow at a CAGR of 8.72% to reach $59.23 billion by 2030, may face challenges due to these tariffs. Higher costs for importing processed recyclables could deter recycling efforts, potentially leading to increased landfill usage and environmental concerns.

Moreover, the tariffs may prompt the affected countries to seek alternative markets, which will realign global recycling trade flows. This shift could result in short-term market volatility and necessitate domestic recycling policies and infrastructure adjustments. While the tariffs aim to bolster domestic industries, the recycling sector's intricate international dependencies mean that such measures could inadvertently hinder recycling rates and sustainability goals globally.

In summary, the "Liberation Day" tariffs will likely introduce significant challenges to the global recycling trade, affecting industry growth projections and potentially impeding progress toward a more sustainable and circular economy.

monds, apples, and some electronics. This shows how developing countries may react to protectionist policies from larger nations by implementing their own tariffs.

The current imposition of reciprocal tariffs is based on Trump's view that American businesses have been disadvantaged by what he perceives as unfair trade practices by other countries. He seeks to level the playing field by implementing tariffs that mirror those put in place by trading partners.

These tariffs are seen as a way to protect domestic industries from foreign competition that may benefit from lower production costs or government subsidies. By imposing similar tariffs on imported goods, Trump aims to support American industries and encourage domestic production.

He further believes that the threat of reciprocal tariffs can give the U.S. leverage in trade negotiations and lead to more favorable outcomes for American businesses.

The use of reciprocal tariffs has sparked controversy both domestically and internationally. Earlier instances of such levies have shown that such measures can escalate trade tensions and lead to retaliatory actions by other countries, potentially harming global trade relationships and causing economic disruptions.

Further, the reciprocal tariffs signal that U.S. will not tolerate what it sees as exploitative or unbalanced trade policies, such as selling below cost to kill competition or currency manipulation.

The goal is to pressure other countries into negotiating better deals or dropping their own barriers. As a tit-

> ***The US plan to impose reciprocal tariffs will have a limited impact on India and may present opportunities for the country. Unlike major US trade partners such as China, Mexico, and Canada, India is relatively well-positioned, which faces tariffs ranging from 20-25% and accounts for 50% of US imports. While specific sectors might face minor challenges, the overall impact is expected to be minimal.***
>
> **PRAVAKAR SAHOO**
> Programme Director, Niti Aayog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MR SHINE

'WE ARE WAITING AND WATCHING THE EMERGING SCENARIO'

Brian Shine, ***Board Chair and CEO, The Canadian Association of Recycling Industries (CARI) For U.S. Region, shares his thoughts***

On April 2, 2025 US President Trump implemented new global reciprocal and universal tariffs during his Liberation Day speech. As per White House Fact Sheet, Canada is excluded from these new universal 10% tariffs. The current emergency tariff USMCA exemptions are still in place and recycled material shipments must continue to have a USMCA Certificate of Origin to be exempted.

Just a slight adjustment in that it is not the section 232 tariffs (alum and steel) that will immediately hurt the recycling trade between US and Canada along with Mexico but rather the Emergency Border Tariffs that are scheduled to be put in place April 2nd. If that happens all goods passing into the US will be tariffed at 25% and this currently include all recycled goods. This will then immediately stop the flow of goods for recycling into the US. Then Canada will retaliate and the goods that flow into Canada will also stop.

CARI has submitted its position to the federal government through the online public consultation process which was due by April 2 and it has also sent correspondence directly to the Ministries responsible for trade and tariffs. It continues to advocate for CARI's position with elected officials within its networks as it is able and encourage its members to do the same, including engaging with the local MPs.

for-tat strategy, it has been a recurring theme in U.S. policy, especially when dealing with trading partners accused of skewing the rules.

The White House held that these tariffs strived to "strengthen the international economic position of the United States and protect American workers."

Trump argued that India subjected the U.S. to 52% tariff rates in contrast to Washington charging "almost nothing for years and years and decades."

The U.S. reciprocal tariffs impose a 27% levy on most Indian goods, with specific 25% tariffs on automobiles, auto parts, steel, and aluminium, and exemptions for pharmaceuticals and semiconductors. More than 50-60% of Indian exports will not be impacted, only 10-40% of auto and electronics exports will be highly impacted.

Despite the tariff impact on automobiles and electronics, India's export trade is not likely to be severely affected for several reasons, like limited exposure to the US, its sectoral resilience, competitive edge thanks to lower tariffs, and ongoing trade negotiations.

The USA has imposed reciprocal tariffs on various countries, with particular attention given to the BRICS nations Brazil, Russia, India, China, and South Africa, which reflect the trade dynamics between the United States and these emerging economies, which are key players in the global market.

The high tariffs on China align with a broader U.S. push to decouple from Chinese supply chains. India, with its growing manufacturing base and English-speaking workforce, could be a natural alternative.

Taiwan's 32% and Vietnam's 46% tariffs outpace India's 26%. Vietnam, despite its rapid manufacturing growth, has become less attractive under this tariff regime. India could capture market share in labour-intensive sectors like apparel and electronics assembly, where Vietnam and Taiwan have been strong.

India has been proactively courting U.S. businesses, with initiatives like tariff cuts signalling openness to trade. Its pharmaceutical sector, already a major U.S. supplier, benefits from tariff exemptions in some cases, further boosting its appeal.

India's large, skilled labour pool and government incentives, including programmes like Make in India, support manufacturing growth. While it

"The government is working on a bilateral trade agreement as was decided between Prime Minister Modi and US President Trump in February. India had a series of engagements, all of which are going in the right direction."

PIYUSH GOYAL
Minister of Commerce and Industry, Textiles and Consumer Affairs, Food and Public Distribution

MR DAGA

Global Scrap Trade Disrupted

The U.S. trade tariffs are compelling global recycling companies, including India, to adapt their sourcing strategies amid changing dynamics, writes **Sandeep Daga,** Founder and CEO of Metal Intelligence Centre

Over the last three months, the United States has announced a series of tariffs to address trade imbalances. Starting March 12, a 25% import tariff has been applied to all steel and aluminium imports (excluding scrap). Additionally, imports of automobiles and auto parts into the US have attracted a 25% tariff since April 2. Further, the US President announced 10% tariffs on global metal scrap, with higher rates for specific countries (e.g., EU 20%, India 26%, Vietnam 46%). These higher tariffs are suspended until July amid concerns over trade impacts. Additionally, an Executive Order launched an investigation into whether rising copper imports threaten US national security and economic stability, aiming to address supply chain vulnerabilities and boost domestic production.

U.S. AS A MAJOR PLAYER

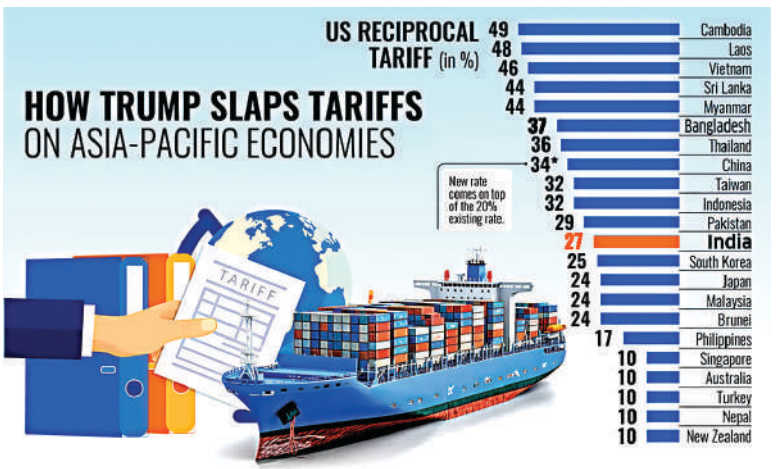
Recycling is essential to the US copper and aluminium supply. In 2024, 720,000 tons of copper were recovered from new (manufacturing) scrap, while 180,000 tons came from old (discarded) scrap, accounting for 35% of the total copper supply. Similarly, 3.8 million tons of aluminium were recovered, with 56% from new scrap and 44% from old scrap. Aluminium from old scrap met 37% of apparent consumption.

The US is a major exporter of metal scrap. In 2023, it exported 880,000 metric tonnes of copper scrap, with China as the largest importer (37.2%), followed by Canada (10.8%), India (8.3%), and others. Meanwhile, in 2024, the US exported 1.6 million tonnes of aluminium scrap, making it the top aluminium scrap exporter globally. India (28%) was the leading importer, followed by Malaysia (21%), Mexico (14%), and South Korea (13%).

IMPLICATIONS FOR THE INDIAN RECYCLING TRADE

The Indian recycling trade faces significant shifts due to changes in the import-export dynamics of US metal scraps. Approximately 20% of US scrap imports into India are high-purity materials like sheets, foils, and beverage cans. However, trade sources indicate that imports of these high-purity scraps from the US have largely ceased, necessitating Indian recyclers to seek alternative sources.

In parallel, the US is poised to add 1.2 million tons per annum (tpa) of recycling capacity between this year and the next. This expansion will amplify the demand for high-grade scrap to feed the increased capacities, potentially turning the US into a net importer of such materials. Europe, the UK, Saudi Arabia, and the UAE are key exporters of scrap to the US.



With a 10% reciprocal tariff on scrap imports and a 25% tariff on aluminium products, US recyclers enjoy a 15% duty protection advantage. This allows them to influence global pricing of high-purity aluminium scrap, impacting recyclers outside the US. In India, low-purity scrap for automotive applications will still be imported from the US, given the need for economical labor for sorting and segregation. However, Mexico may emerge as a stronger recycling hub to cater to US demand in the medium-term.

Meanwhile, copper scrap exports from the US remain unaffected, supported by the lack of domestic recycling capacity and rising copper prices at the Chicago Mercantile Exchange. This creates an opportunity for new recycling capacities in the US, Mexico, or Canada.

MR BANGERA

'US TARIFF AN OPPORTUNITY ON PLATTER FOR INDIA'

Subha Bangera, a plastic industry veteran, feels that the US tariff measures are a boon to India, which will be ably assisted by the ongoing Chinese slowdown and the meltdown in Europe

Too much hype has been created on the US first cut tariff submission. What we have to look at is how is it effecting our Vision 2047. Today Indian exports to US is 2.2% of our GDP.

We need to target double digit exports by 2032. For this we need more exports to USA. And this tariff is giving us that opportunity on a platter.

We will be competitive against suppliers from China, Vietnam and even Europe in many areas. The tariff on these countries will increase the landed cost of their goods in USA.

Our consumer goods and capital goods industries will have exponential jump with the USA tariff structure on China and Vietnam. Let us not forget that more than 75% of companies in Vietnam is owned by Chinese investors.

India should do a thorough analysis of USA imports from China and Vietnam and counter offer a lower landed price for goods originating from India. Indulge in opportunity and not looking for short term benefits.

I was part of the team which worked on how to improve our exports in the capital goods.

We always felt that we should build quality and consistent products like Europe and at Chinese costs. We have to focus on exports to so called 13 emerging countries. This is the strength of China today. They have taken all the business of emerging countries.

We have definite opportunity to multiple our exports to USA and allies for being cost competitive with China, thanks to the higher tariffs to Chinese products.

The tariff by USA will reduce effective profit of trading companies, but that will not have any impact on manufacturers.

Manufacturers have to gear up to expand their capacities ASAP. India's zeal supported by Chinese slowdown and European meltdown will uplift the country to a different but higher platform.

lacks China's scale, it offers a viable alternative for U.S. firms seeking to hedge against tariff risks elsewhere.

However, India's manufacturing infrastructure lags China and the EU, potentially limiting its ability to absorb large-scale shifts quickly.

In its response, India said that it is carefully examining the implications of Trump's announcement and studying the opportunities that may arise due to this development in the American trade policy.

The Union commerce ministry had said it was engaged with all stakeholders, including Indian industry and exporters, taking feedback on their assessment of the tariffs and assessing the situation, keeping in view the vision of a developed India.

The US sent its officials only to India for negotiations on tariffs after Trump took office in January. India and the US are now trying to expedite the bilateral trade agreement that will be mutually beneficial and will cover a range of issues, including deepening supply chain integration, according to the Ministry.

India is negotiating with seven countries for a free trade agreement, and trade talks will soon begin with Bahrain and Qatar, sources pointed out, suggesting that such deals would resolve the tariff tangle. New Delhi will also find new markets for its marine and jewellery products and other sectors impacted by the tariffs.

According to the PHD Chamber of Commerce and Industry (PHDCCI), the tariff on Indian exports could impact only 0.1% of the GDP due to the country's price competitiveness and supportive government policies.

More importantly, the changes that the new tariff regime would bring are expected to provide Indian exporters an opportunity to expand their footprint in products and sectors impacted by the tariff.

The Federation of Indian Export Organizations (FIEO) expects market opportunities to grow by over $50 billion for Indian exporters due to the tariffs.

> ***The new tariffs could be a significant blow to China's economy that could slash Beijing's growth by 2.4 percentage points. China, which has set a 5 per cent growth target for the year, may fall short if the trade tensions intensify.***
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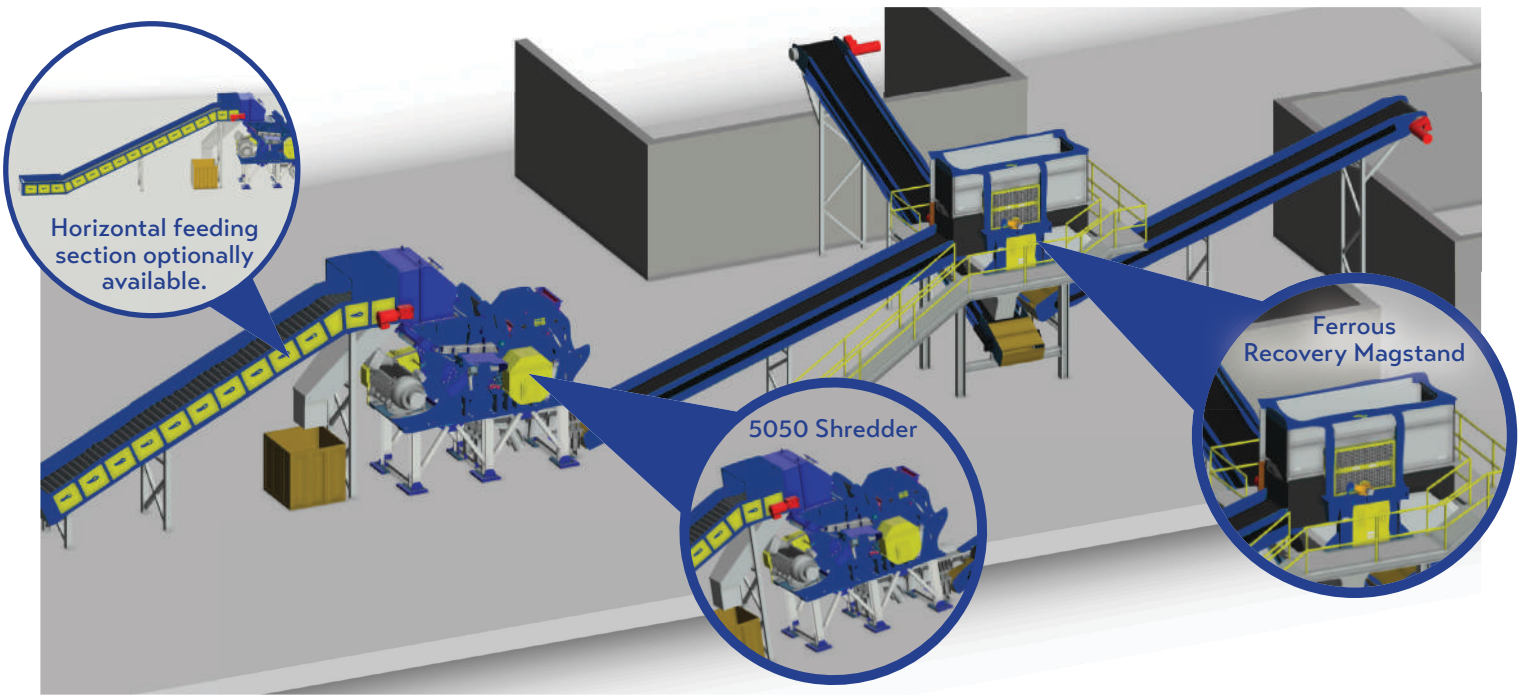

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COPPER MARKET

Caught in the Crossfire

Due to increased demand primarily from renewable energy, EVs and data centre industries, copper prices have displayed varied movements. Analysing the headwinds, Aurobindo Gayan of Blueglance tries to uncover the layers of complexity surrounding the metal

Copper prices have seen a dramatic turnaround in recent weeks, with the entire 16% rally from the first quarter of 2025 wiped out in just a few trading sessions in April. The sharp correction came as US President Trump's aggressive tariff measures reignited recession fears, triggering a broad-based selloff across global financial markets — and copper was no exception. However, this presents some buying opportunities for some Chinese consumers, particularly amid prevailing tightness in the physical market.

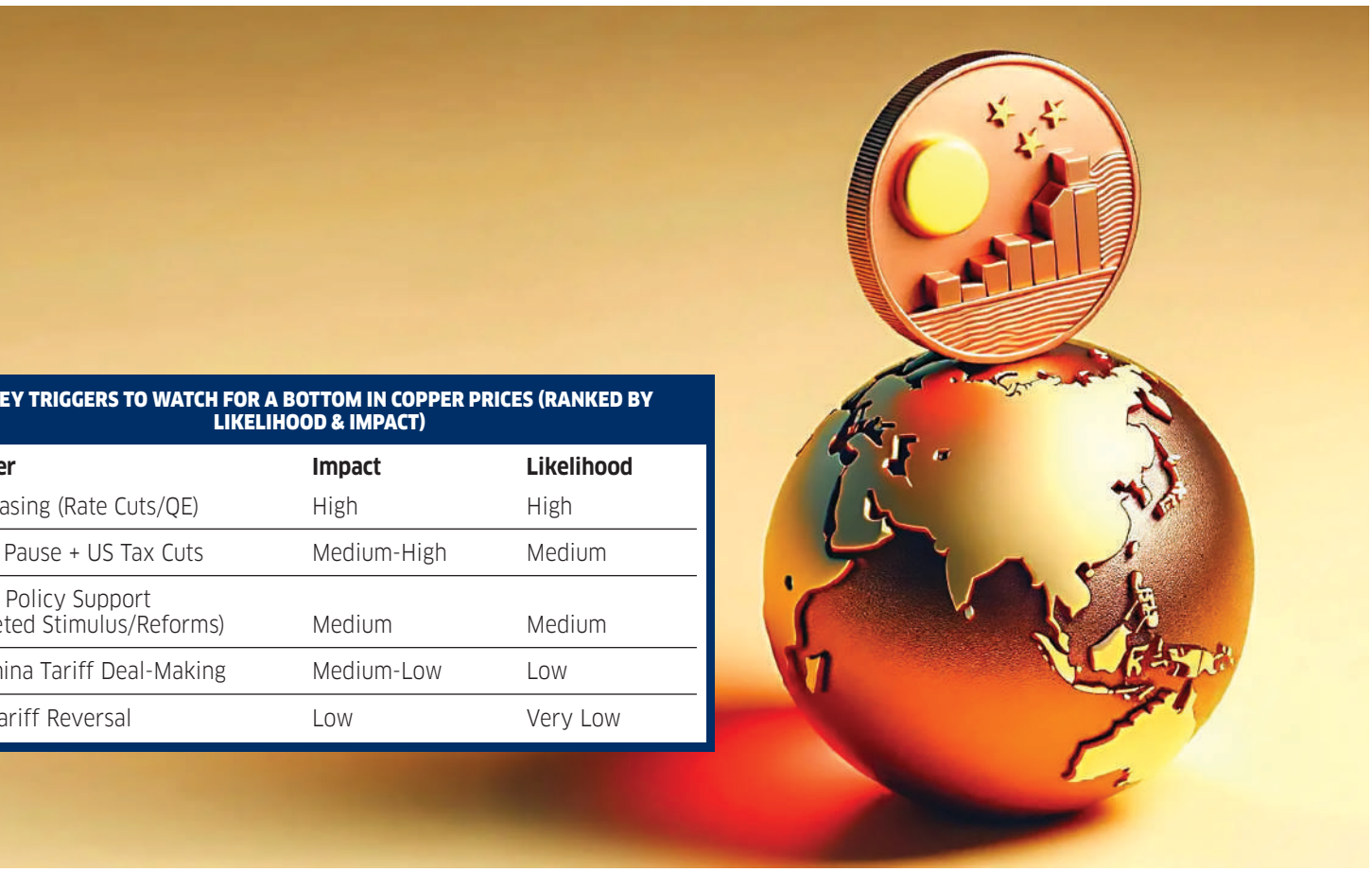
SHOCKS AND UNCERTAINTIES

Tariff-related developments, aggressive policy actions, and political manoeuvrings have thrown the copper market into a state of flux. President Trump's plan to roll out reciprocal tariffs and Section 232 levies on imports will drive a sharp slowdown in global growth, forcing physical demand for copper—and speculative positioning — to weaken further.

With little sign of progress on trade negotiations, retaliatory tariffs from China and Europe — coupled with deflationary impulses outside the US and a potential buyers' strike within the US — leave copper exposed to further downside risk.

THE MEDIUM-TERM SUPPORT

While near-term headwinds dominate, there is some light at the end of the tunnel. Global policymakers, including the US Federal Reserve, have room to respond to this slowdown through monetary easing.



EY TRIGGERS TO WATCH FOR A BOTTOM IN COPPER PRICES (RANKED BY LIKELIHOOD & IMPACT)

er	Impact	Likelihood
asing (Rate Cuts/QE)	High	High
Pause + US Tax Cuts	Medium-High	Medium
Policy Support eted Stimulus/Reforms)	Medium	Medium
hina Tariff Deal-Making	Medium-Low	Low
ariff Reversal	Low	Very Low

In particular, the US Fed could cut interest rates down to 3.25% or lower and potentially restart quantitative easing (QE) — a signal that has historically supported risk assets like copper (as seen in March 2020). Moreover, with the 2026 US mid-term elections in sight, there is a clear incentive for the administration to ensure a growth rebound by the first half of 2026. That said, any bullish recovery for copper and other commodities may only materialize from lower price levels and after policy responses have gained traction.

CHINESE SCRAP ADDS TO WOES

Adding another layer of complexity is China's looming copper scrap supply crunch following its retaliation against US tariffs. Beijing's swift response — a 34% tariff on US goods mirroring Washington's latest measures is set to effectively halt copper scrap imports from the US starting in May.

Estimates from the Shanghai Metals Market suggest US scrap shipments to China may not exceed 100,000 tons in the first four months of 2025, a sharp drop from the nearly 440,000 tons imported in 2023.

Despite global ore scarcity, China has aggressively expanded its copper smelting capacity in recent years. This has driven processing fees into negative territory — meaning smelters now have to pay to process concentrates into refined copper.

OUTLOOK

The copper market is likely to remain volatile and vulnerable to policy-driven swings in the near term. A combination of slowing global activity, rising trade tensions, and supply dislocations, particularly in scrap flows to China, may keep prices under pressure.

However, once the dust settles and policy responses start to gain traction, copper's medium- to long-term fundamentals, driven by energy transition demand, supply tightness, and infrastructure spending, could reassert themselves.

TECHNOLOGY

Revolutionizing Plastic Recycling with Irradiation

Beyond traditional recycling, irradiation also paves the way for innovative approaches, allowing plastic wastes to blend with other materials to create durable products and ensure high-quality manufacture, says research finding by the International Atomic Energy Agency (IAEA)

The scourge of plastic pollution is nothing new. Natural polymers such as rubber and cellulose were widely used before synthetic plastics emerged with the Belgian chemist Leo Baekeland's invention of the first wholly synthetic plastic, Bakelite, in 1907.

By the mid-20th century, global plastic production per year reached about 2 million tonnes. Today, with annual production surpassing 400 million tonnes, it is nearly impossible to go a day without coming across some form of plastic. If business continues as usual, global production of primary plastic is forecast to almost triple, reaching 1100 million tonnes by 2050.

Scientists and technologists are making headway in research to tackle the global crisis of plastic pollution. Recycling and upcycling efforts are intensifying as the most viable options for managing plastic wastes, with radiation technologies emerging as an innovative, clean, and efficient tool to convert used plastic together with biomass into new products.

CHALLENGES IN CONVENTIONAL RECYCLING

Plastic is not biodegradable. Instead of decomposing, it fragments into smaller pieces, resulting in microplastics. These can be found everywhere; from the air we breathe to the oceans in Antarctica. Despite recycling efforts, less than 10 percent of the world's 7 billion tonnes of plastic waste generated globally to date has been recycled.

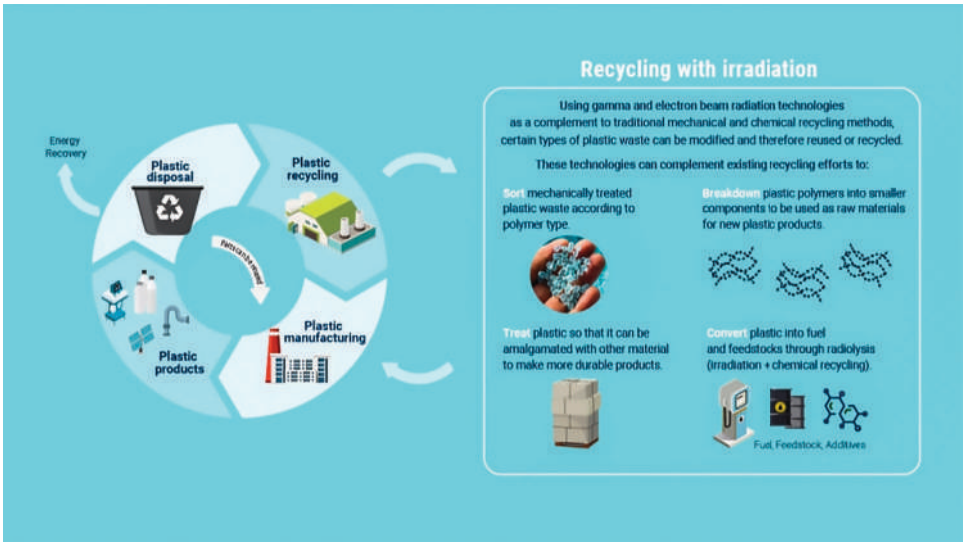
School chairs produced cheaply in the Philippines using conventional recycling techniques. Upcycling, the higher-value recycling of plastics, could be achieved by using irradiation, which can enable the use of novel materials in various applications. (Photo: M. Gaspar/IAEA)

Currently, mechanical and chemical recycling are the two major recycling techniques available for application. Mechanical recycling is the most common method, salvaging similar plastics to produce raw materials that can be re-integrated into plastic production. The process involves collecting, sorting, washing, and grinding the plastic to be melted and re-processed into new materials.

While relatively cheap, this type of recycling requires the sorting of different polymers, making it difficult to process multi-layered or mixed plastics. Additionally, the process cannot be used more than twice as the quality of recycled materials degrades with each cycle, and it only applies to thermoplastics (those that can be re-melted and reshaped into products).

Chemical recycling, on the other hand, can process a wider variety of mixed plastic waste, including contaminated and low-quality waste, by breaking them down to their molecular components, transforming them into substances that can be used for producing new plastics or other products, such as fuel. This method is rather costly as it requires high energy inputs, and developing large-scale chemical recycling facilities requires significant investments in infrastructure.

"The world's commitment to ending plastic pollution is clear and undeniable," said Inger Andersen, Executive Director of the UN Environment Programme (UNEP), when the fifth negotiation session for an international legally binding instrument on plastic pollution, including in the marine environment, ended in Busan, Republic of Korea, in December 2024.



> ***Despite recycling efforts, less than 10 percent of the world's 7 billion tonnes of plastic waste generated globally to date has been recycled***

As representatives from more than 170 nations and observers from hundreds of organizations roll up their sleeves for the next session in Geneva, Switzerland, scientists and technologists are making headway in research to tackle the global crisis of plastic pollution. Recycling and upcycling efforts are intensifying as the most viable options for managing plastic wastes, with radiation technologies emerging as an innovative, clean and efficient tool to convert used plastic together with biomass into new products.

HOW CAN IRRADIATION HELP?

Radiation technology using gamma and electron beams offers unique advantages to reduce plastic waste by offering a cleaner production and recycling process, avoiding the use of potentially harmful additives, and improving energy efficiency.

"The main benefit of irradiation in plastic recycling stems from its ability to alter the chemical structure of plastics at a molecular level," said Azillah Binti Othman, Radiation Processing Officer at the IAEA. "Irradiation can help reduce plastic waste volumes in two ways: by increasing the re-purposing of hard-to-recycle plastics into valuable products and by developing bio-based plastics to reduce reliance on petroleum-based plastics."

Irradiation using gamma rays or electron beams can complement conventional methods of plastic recycling. (Infographic: R. Kenn/IAEA)

Irradiation is a very effective tool in sorting recycled plastic, which has already been washed and ground, according to the type of polymers. This improves the purity of the recycled plastic and, thus, its value.

Irradiation can also complement and enhance traditional recycling methods. When combined with a chemical recycling method known as pyrolysis,

resulting in radiolysis, plastic waste polymers can be broken down and converted into fuel or chemical components to create new products without adding virgin (non-recycled) polymers.

Workers waiting for plastic pellets in cardboard boxes on a conveyor belt to be transported into the irradiation chamber in an electron beam facility in the Philippines. (Photo: PNRI)

Beyond traditional recycling, irradiation also paves the way for innovative approaches, allowing plastic wastes to be blended with other materials to create more durable products. This facilitates the manufacturing of high-performance material that finds applications in the automotive or construction industries. For instance, construction materials made from recycled plastic, such as tiles, bricks, lumber, and boards, are irradiated in the Philippines to improve their tensile and sheer strength, abrasion resistance, and other mechanical properties.

In addition, radiation-assisted technology is also showing promise in making more durable final products when using biomass, a renewable resource. This allows the creation of bio-based plastic and other high-value compounds, such as novel packaging materials that would replace conventional petroleum-based plastics.

Irradiated plastic waste was used as a compatibilizer for this thatch in Indonesia, made out of recycled plastic and rice husk. (Photo: Vero)

> ***The focus on the first front is on reducing plastic waste volumes through innovative upcycling, increasing the re-purposing of hard-to-recycle plastics***

NUTEC PLASTICS: FROM RECYCLING TO MONITORING MICROPLASTICS

The IAEA is harnessing the power of radiation technologies through its NUTEC Plastics initiative to assist countries in dealing with plastic pollution on two fronts: at the point of source, by introducing new technologies to improve plastic recycling; and in the ocean, where the bulk of plastic waste ends up.

"The focus on the first front is on reducing plastic waste volumes through innovative upcycling, increasing the re-purposing of hard-to-recycle plastics into valuable products and developing bio-based plastics," said Celina Horak, Head of the IAEA Radiochemistry and Radiation Technology Section. "With the help of the NUTEC Plastics initiative, nine countries across Asia, Latin America and Africa are in the process of establishing radiation-assisted pilot plants."

The role of irradiation in helping to beat plastic pollution will be discussed during the IAEA's upcoming Third International Conference on Applications of Radiation Science and Technology. Gathering hundreds of experts from radiation-related physics, chemistry, materials science, biology, and engineering fields in Vienna, Austria, from 7 to 11 April 2025, #ICARST2025 will be accessible to anyone interested via live streaming.

International events will also be held in October 2025 in the Republic of Korea, featuring IAEA tools for circular economy assessment and for technological maturity level, and in November 2025 in the Philippines, the first international high-level forum on NUTEC Plastics. Both events will include the other aspect of the NUTEC Plastics initiative, the marine monitoring component, where nuclear science is used to identify, trace, and monitor plastics in the ocean, particularly microplastics.

(The article was written by the Department of Nuclear Sciences and Applications of International Atomic Energy Agency).

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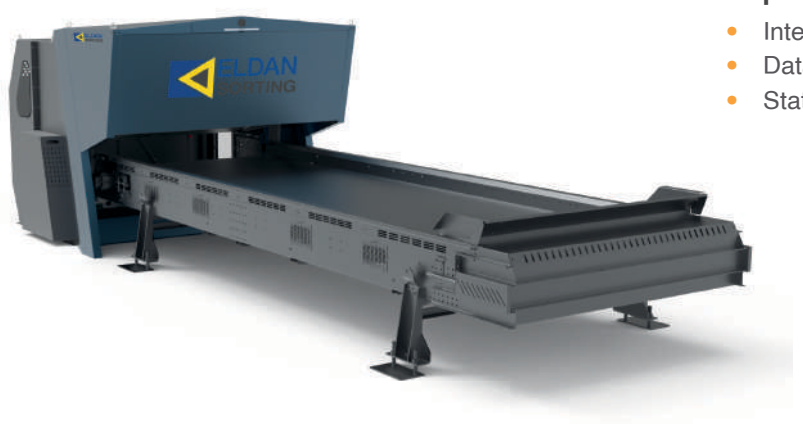

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Operating in a closed, gas-tight system, the filtration process ensures safety and containment, even allowing inert atmosphere processing. Designed for a 6-bar operating pressure, the PF complies with strict European ATEX regulations. Components in contact with corrosive substances use robust materials like super-duplex steel or Hastelloy, ensuring durability.

Additionally, the PF incorporates a specially designed discharge system, featuring an endless liner and custom emptying mechanism, protecting the product from contamination and ensuring operator safety. This state-of-the-art solution exemplifies engineering excellence in sustainable metal recovery, making it indispensable for industries handling precious metal-rich waste.

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Designed to handle high processing capacities, FORREC shredders operate without screens, enabling the processing of large material flows with ease. The Multi-Crusher LC version is specialized for tasks such as processing Waste Electrical and Electronic Equipment (WEEE) and opening baled materials. Its versatility makes it a valuable addition to industries dealing with compacted plastics and waste materials.

The LC 2000 model features impressive specifications, including dimensions of 2400 x 6280 mm (height: 4030 mm), a cutting chamber size of 1300 x 1960 mm, and disc-shaped blades. Weighing 13,000 kg, it offers blade thickness options of 75 mm or 100 mm, powered by motorization of 1×22 kW and 1×55 kW, and delivers high torque for challenging materials.

FORREC shredders excel in applications such as WEEE processing, baled plastics, and baled waste. Their eco-friendly design ensures low environmental impact, while their reliability, high torque, and robust construction address the most hostile shredding requirements. With low maintenance costs and versatile performance, FORREC double-shaft shredders provide an exceptional solution for industries striving for efficiency and sustainability.

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SUSTAINABILITY

Pushing the Agenda

Fit for a developing economy, the Government of India is seriously focusing on decarbonization, circularity and sustainability-driven pro-grammes and projects. Here is a glimpse of such activities, as they are presented to the Parliament

India is making significant strides towards building a self-reliant circular economy, minimizing waste, and fostering sustainability across industries. Recent parliamentary discussions have underscored various initiatives undertaken by the government to address environmental challenges, including the management of plastic waste and the development of innovative recycling technologies.

The Technology Development Board (TDB), a statutory body under the Department of Science and Technology (DST), has partnered with APChemi Private Limited, to commercialize purified pyrolysis oil. This oil allows downstream production of circular plastics and sustainable chemicals, establishing a robust infrastructure for eco-friendly industrial solutions.

Additionally, efforts by the Council of Scientific & Industrial Research (CSIR) have revolutionized plastic waste recycling. CSIR's collaboration with the Delhi Development Authority (DDA) and Municipal Corporations of Delhi has led to the establishment of a plant converting waste plastic into diesel and tiles. Technologies developed by CSIR's Indian Institute of Petroleum (CSIR-IIP), Dehradun, and National Physical Laboratory (CSIR-NPL), Delhi, are at the forefront of these advancements. Similarly, CSIR-Indian Institute of Chemical Technology (CSIR-IICT), Hyderabad, has leveraged cutting-edge methodologies to convert plastic waste into value-added products, including green plasticizers, monomers, fuel oil, and hydrogen.

Furthermore, innovative financial support from DST's TDB has catalyzed the development of an integrated plant for recovering precious metals from e-waste and other industrial residues. Commercial plants to recycle lithium batteries and e-waste using indigenous technology are paving the way for sustainable practices.

To improve its R&D, the Department of Chemicals and Petrochemicals (DCPC) has established 18 Centres of Excellence (CoE) dedicated to eco-friendly processes by focusing on biodegradable products, renewable feedstocks, and minimizing waste generation.

Ministries that contribute to this collective vision are:

- The Ministry of Environment, Forest, and Climate Change (MoEF&CC) enforces the Plastic Waste Management Rules, including amendments in 2021 that mandate Extended Producer Responsibility (EPR) for plastic packaging and recycling. The ban on single-use plastics since 2022 complements these efforts.
- The Ministry of Petroleum and Natural Gas (MoP&NG) accelerates biofuel production, reducing dependence on crude oil imports and creating rural employment opportunities.
- The Ministry of Housing and Urban Affairs (MoHUA) promotes circularity in plastics through Material Recovery Facilities (MRFs) nationwide, employing thousands in waste segregation and recycling.
- DST's Waste Management Technologies (WMT) program actively supports research to manage industrial residuals and lifestyle-generated waste.

With CSIR sanctioning ₹ 345 crores for sustainability projects over the past three years, the government is taking significant steps to strengthen indigenous technological capabilities. These efforts collectively contribute to employment generation, reduce environmental impact,.

Dr. Jitendra Singh, Union Minister of State (Independent Charge) for Science and Technology, Department of Atomic Energy, and Department of Space, gave this information during the question hour of a parliamentary session.

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STOCK MARKET

Resource Recycling IPO is coming

Another leading non-ferrous metal recycling company is ready to take the plunge into stock market

Chennai-based Resource Recycling Limited has filed Draft Red Herring Prospectus (DRHP) with the Securities and Exchange Board of India (SEBI) for an initial public offering (IPO) to raise up to Rs 2,000 crore.

The new non-ferrous metal recycling industry, Jain Resource Recycling Limited specialises in producing a wide range of products, including lead and lead alloy ingots, copper and copper ingots, aluminium and aluminium alloys, as well as refined gold.

The company seeks to raise up to ₹ 2,000 crore from the issue, which comprises both a fresh issue of up to Rs 500 crore and an offer for sale (OFS) of up to Rs 1,500 crore by the selling shareholders. It aims to leverage the IPO proceeds to strengthen its financial position, reduce debt, and support its strategic expansion plans. The listing is also expected to enhance the company's visibility and brand image among existing and potential customers.

Through the IPO, the company aims to capitalize on growth opportunities, reduce debt, and solidify its position in the non-ferrous metal recycling industry. It has outlined strategic initiatives to expand its gold refining operations and diversify into heavy minerals. Additionally, it plans to forward integrate into copper cathode and wire rod manufacturing while maintaining a strong focus on sustainability and environmental, social, and governance (ESG) principles.

According to the Draft Red Herring Prospectus (DRHP) filed on March 30, the offer for sale includes equity shares worth up to ₹ 1,430 crore from Kamlesh Jain (promoter of the company) and equity shares valued at ₹ 70 crore from Mayank Pareek (Joint Managing Director). The company intends to allocate the net proceeds for pre-payment or scheduled repayment of a section of its outstanding borrowings and for general corporate purposes.

The company partnered with Ikon Square Ltd UAE for the purposes of setting up its gold refining facility in Sharjah UAE. It is also engaged in the trading of non-ferrous metals and other commodities.

The IPO will be managed by DAM Capital Advisors, ICICI Securities, Motilal Oswal Investment Advisors, and PL Capital Markets. KFin Technologies will act as the registrar. The company has a clientele that includes names such as Vedanta, Mitsubishi Corporation, and Nissan Trading Company.

Jain Resources is part of the Jain Metal Group, which has a rich legacy spanning seven decades, having established itself as a pioneer in the recycling and production of non-ferrous metals in India.

According to CRISIL, it is India's largest and fastest-growing non-ferrous metal recycling business, in terms of revenue for Fiscal 2024, Fiscal 2023 and Fiscal 2022. The group's success can be attributed to its state-of-the-art infrastructure and capabilities to handle multiple products in recycling at a single location, as well as its extensive global network for sourcing recyclable materials.

Its product portfolio comprises of lead and lead alloy ingots; copper and copper ingots; and aluminium and aluminium alloys. It is also one of the two recycling companies in India that got its lead ingot registered as a brand by the London Metal Exchange (Source: CRISIL) which provides the Company a distinct advantage of access to a broader customer base by offering products compliant with international quality standards along with the benefit of LME reference pricing with respect to supply of its products in global markets.

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TEXTILE RECYCLING
Towards Zero Waste

The global spotlight is on the critical need to eliminate waste from one of the most waste-intensive and environmentally impactful industries: fashion and textiles. The sector utilizes a substantial number of resources like water, chemicals, and energy and, in turn, generates massive amounts of waste, threatening the overall human and environmental welfare and underscoring the urgency of adopting sustainable and circular practices.

HISTORY AND SIGNIFICANCE

Recognizing the escalating waste crisis, the UN General Assembly, in its 77th session, adopted the resolution, proclaiming 30th March as the International Day of Zero Waste. The resolution, first put forward by Türkiye along with 105 other countries, including India, was unanimously adopted on 22nd December 2022. Jointly facilitated by the UNEP and UN HABITAT, this day aims to draw attention to various themes relevant to the global waste crisis.

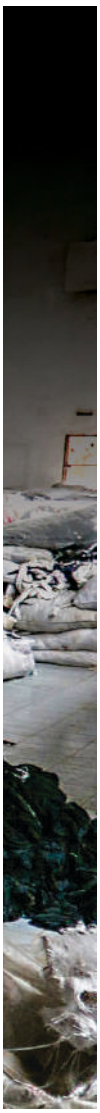
The theme for the 2025 edition, 'Towards Zero Waste in Fashion and Textiles, ' underscores the urgent need to evaluate and assess the rising environmental concerns associated with the fashion and textile sector. It also aligns closely with the goals and targets of the 2030 Agenda for Sustainable Development, particularly Sustainable Development Goal 11 and Sustainable Development Goal 12. These goals address sustainable management of resources and environmentally sound handling of all waste to minimize their adverse impact on human health and the environment.

CRISIS AND ITS IMPACT

Globally, clothing and textile waste account for 7 percent of the total waste in landfills. The challenge lies not only in the quantity of waste being generated but also in the complex nature of textile materials. Most garments today are made from blended fabrics such as cotton and polyester that are difficult to separate and recycle using conventional methods. Additionally, the lack of adequate infrastructure, especially in developing economies where textile waste is growing rapidly, further compounds the challenge of mismanagement. Collection systems are fragmented, sorting facilities are inadequate, and recycling technologies are either underdeveloped or economically unviable. The sheer volume of garments

It's time we adopt more circular practices to combat textile waste and create a waste-free and responsible fashion industry, writes **Shweta Gautam,** Area Convenor, Centre for Waste Management at TERI

MS. GAUTAM



discarded because of fast fashion and over-consumption places an additional burden on the existing systems.

India stands at a crucial crossroad. As the world's sixth-largest exporter of textiles and apparel, the sector contributed to 8.21% of the country's total exports in 2023-24. The market for Indian textiles and apparel is projected to grow at a 10% CAGR to reach US$ 350 billion by 2030, with exports expected to reach US$100 billion. The stakes are high, as this booming sector grapples with managing ~7793 kilotons of textile waste generated annually, primarily from a) Pre-consumer waste generated during the manufacturing process, including fibers, yarn, fabric, surplus fabrics, and or rejects and b) Post-consumer waste escalating by consumer behaviour trends.

A Mckinsey study estimates, the average person is buying 60 per cent more clothing than 15 years ago, while each item is kept for only half as long. With the increasing demand for quick and cheap fashion and the absence of adequate waste management systems and circular practices, this mounting waste poses serious sustainability challenges.

At its core, zero-waste is a set of guiding principles encouraging the elimination of waste at all stages of the product/ material lifecycle. Additionally, the zero-waste approach pushes a shift from the traditional linear model of "take-make-dispose" to circular systems where waste is minimized by creating loops to retain products and materials at their highest value.

> ***Investing in textile-to-textile recycling technologies and local enterprise can catalyze innovations***

TERI has been at the forefront in catalyzing sustainable practices in India's textile sector. Its report, "A guide to promoting circular economy in textiles in India," outlines a strategic roadmap for integrating the principles of circular economy within India's textile sector. Drawing from the insights collected in Ludhiana's dynamic textile clusters, the report provides a clear pathway for phased transition – from the prevailing state to a desired state focusing on design, production, consumption, and end–of-life stages supported by technology, policy, market structures, and financial mechanisms.

KEY STRATEGIES

Transitioning the fashion and textile industry towards a zero-waste future requires a multifaceted strategy that addresses inefficiencies across the value chain from design to disposal. This transition demands innovation, collaboration, consumer engagement, and robust policy frameworks.

Strengthening Recycling and upcycling infrastructure:

Textile recycling in India is currently limited to mechanical processes, which often compromise the quality of recycled output. This method is limited in its ability to process blended fabrics or synthetic materials that are increasingly common in modern apparel. Coordinated efforts are needed from various players to facilitate the development of an advanced recycling ecosystem in India.

RESEARCH AND INNOVATION

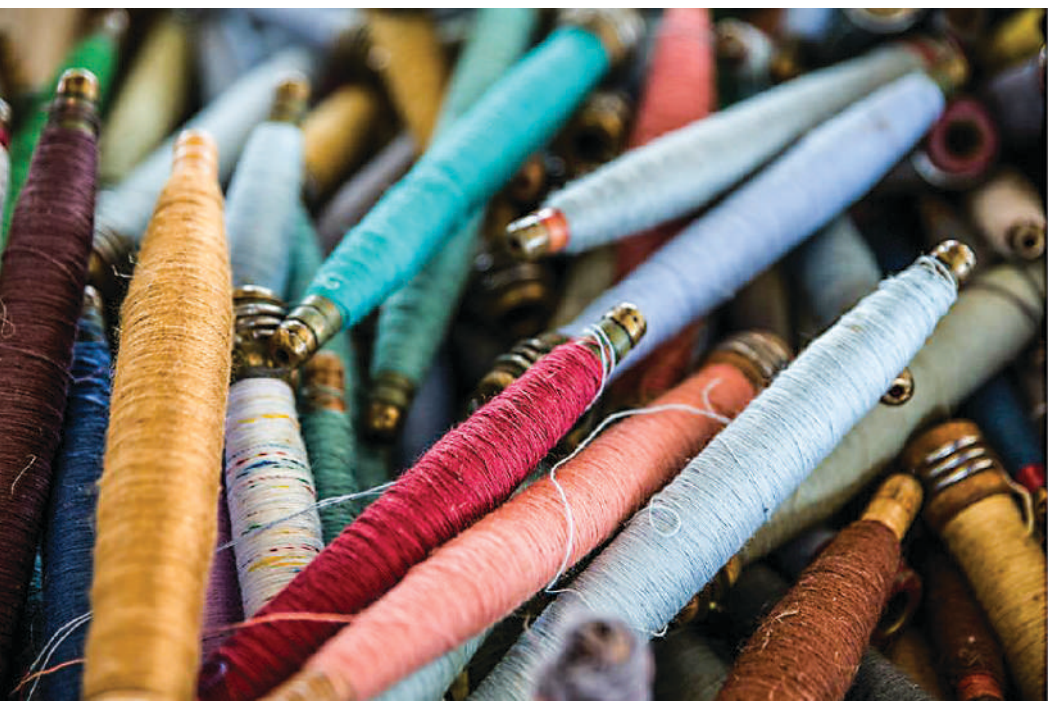
Setting up infrastructure for collection, segregation, and overall streamlining of the post-industrial and post-use textile waste is essential to achieve economic viability. Public-private partnerships and multi-stakeholder collaborations are essential for establishing shared recycling infrastructure and circular supply chains benefiting all players from manufacturers to recyclers. Investing in textile-to-textile recycling technologies and supporting local enterprises/MSMEs can catalyze innovations.

A TRANSPARENT VALUE CHAIN

Building traceability into the overall textile value chain is key to ensuring transparency, enabling better material recovery, and holding the brand accountable. A traceable

system tracks products from their raw material stages to end-of-life, creating a foundation for circularity. Below are some measures that will enable us to maintain transparency across the value chain:

- Introducing a robust EPR framework for textile waste, mandating producers to manage the collection, recycling, and reintegration of discarded products. Learnings from the successful EPR models in plastic, e-waste, batteries, etc., can guide implementation in the textile sector.
- Adopting digital tools such as RFID, blockchain, and AI can improve the tracking of products from raw materials to consumers.
- Encouraging brands to take responsibility for the entire lifecycle of their products and holding brands accountable to manage the post-use textile waste can incentivize brands to implement upstream measures such as designing products for durability, modularity, and recyclability to reduce waste and extend product life.



INCREASING AWARENESS

Consumer awareness and individual actions can play a crucial role in addressing overconsumption and post-use textile waste. Consumers have the power to make conscious choices that will drive demand for low waste and circular fashion better fashion and influence positive change.

Raising awareness regarding the environmental impact of fast fashion and promoting sustainable consumption practices.

Encouraging consumers to follow the principles of the waste hierarchy by minimizing overconsumption to prevent waste being generated in the first place by reusing and repairing whenever possible.

DEVELOPING CIRCULAR SYSTEMS

Adopting a holistic approach is important to address the emerging challenge of textile waste management. The Circular Economy model provides the means to address this challenge through systemic interventions to ensure that products are made to last, easy to disassemble, and suitable for material recovery. It can be achieved by following a few steps, including:

- Implementing zero-waste patterns by prioritizing renewable or recycled materials that can be easily recovered and applying circular design principles to create durable products.
- Reintroducing post-industrial waste into the production process as it is mostly uncontaminated, making for high-quality feedstocks.
- Systematically recovering post-use waste and directing it towards textile-to-textile recycling infrastructure to create closed loop systems, reduce dependency on virgin materials, and achieve economies of scale.

CALL TO ACTION

International Zero Waste Day 2025 offers a powerful opportunity to show that systemic changes require collective efforts. Governments must enact enabling policies, industries must embed sustainability in core operations, communities must support local circular solutions, and individuals must adopt mindful consumption habits.

> ***The stakes are high, we manage ~7793 kilotons of textile waste generated annually***

Moving forward to zero waste in the future requires a shared commitment to build systems that are sustainable, traceable, and circular, ensuring that fashion evolves from being a major contributor to global waste into a leader in environmental responsibility.

(Ms. Gautam is the Area Convenor for the Centre for Waste Management with The Energy and Resource Institute-TERI).).

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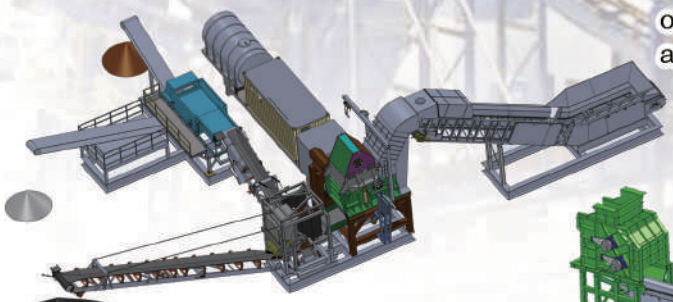

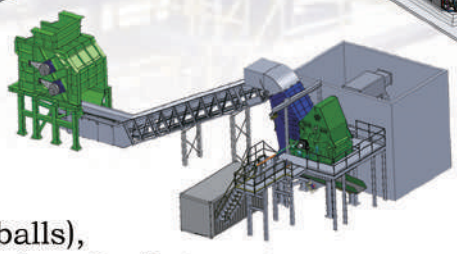

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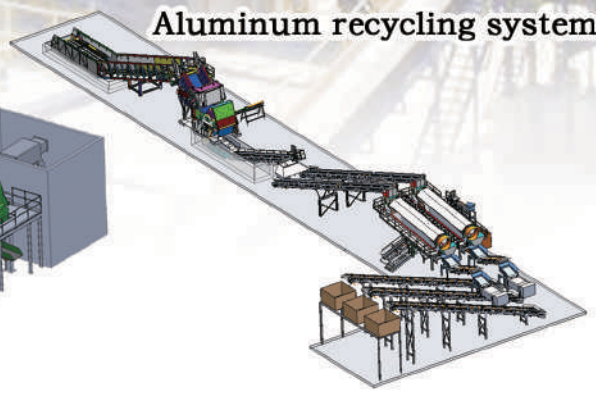

Pre-Shredder

Newell Shredder

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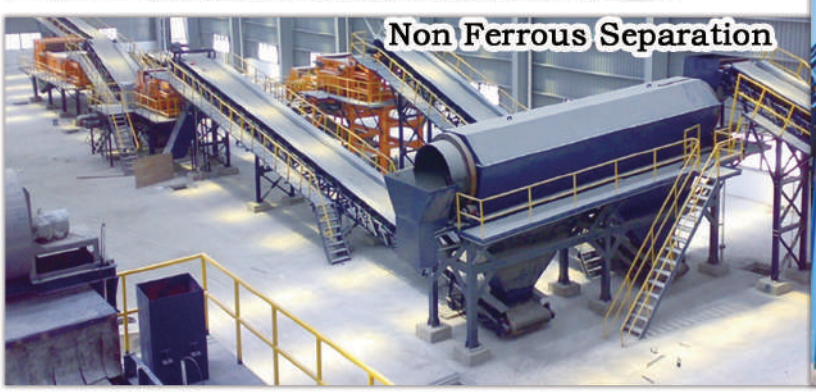

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EU BATTERY WASTE CODES

A Boost to Circular Resource Management

The new codes will lead to better control of shipments of black mass and will ensure that black mass remains in the European economy

Batteries are central to advancing the green transition, promoting sustainable mobility, and achieving climate neutrality by 2050. In battery recycling, access to shredded battery waste, known as "black mass," is key to enabling the recycling of electric vehicle batteries.

The Eueopean Commission, on the 5th of March, revised its List of Waste, to extend the lifespan of batteries and their critical raw materials within the economy. The decision, adopted along with the automotive action plan, sets the stage for a more sustainable and forward-thinking automotive sector.

Jessika Roswall, the Commissioner overseeing Environment, Water Resilience, and a Competitive Circular Economy, stated, "To better protect the environment, the Commission will now classify black mass from batteries as hazardous waste. This will lead to better control of black mass shipments and especially a ban on its export to non-OECD countries. By keeping black mass longer in the economy we can boost battery recycling and our circular economy."

The recent decision clarifies that black mass shall be classified as hazardous waste. In accordance with the Basel Convention and the Waste Shipments Regulation, this will lead to better control of shipments of black mass and will ensure that black mass remains in the European economy. This supports the battery regulation's objective of shifting to a circular economy, in-

creasing security of supply for raw materials and energy, and enhancing the EU's strategic autonomy.

The European List of Waste is a key instrument to properly manage waste in the EU and control waste shipments within and outside the EU. It identifies and classifies all different types of waste, including hazardous waste, which can be harmful to human health and the environment. Established in 2000, this list has since been revised to adapt to scientific and technical progress.

The delegated act draws on the JRC report entitled 'Technical recommendations for the targeted amendment of the European List of Waste entries relevant to batteries', prepared with the input of stakeholders. The new codes were proposed based on scientific and technical information about the chemistry of the different battery types and generated waste.

The classification resulted from the application of established rules for the classification of chemicals and waste. More specifically, the proposed classification of waste as hazardous or non-hazardous is based on up-to-date information about the composition and classification of components according to the EU classification rules provided in the Regulation on Classification, Labelling and Packaging of chemicals (CLP Regulation) and in Annex III of the Waste Framework Directive.

Under international law (the Basel Convention) and the EU's Waste Shipments Regulation, the export of all hazardous waste from the EU to non-OECD countries is banned.

NEW CODES

New specific waste codes have been introduced to identify and support the proper management of waste from different stages of the batteries' life cycle, including:

- Waste from battery manufacturing
- Waste from post-consumer batteries
- Intermediate fractions from battery recycling

The amendment takes into account the emergence of new battery chemistries, introducing new waste codes for lithium-based batteries and intermediate waste streams from battery recycling (black mass) to ensure their proper handling within and outside the EU.

Black mass, lithium-based, nickel-based, and zinc-based waste batteries, and sodium sulphur and alkaline waste batteries are now classed as hazardous. A new hazardous code for lithium-based batteries for separately collected municipal waste has also been added.

The amendment also aims to increase the protection of the environment and human health by ensuring proper management of battery-related waste. More broadly, this should also be seen in the context of a recycling value chain that works well, supporting the application of rules on recycling efficiencies for waste batteries and recycled content in new batteries.

WHAT'S NEXT

The amendment of the List of Waste will enter into force 20 days after its publication in the official journal of the EU if the European Parliament or the Council of the EU do not object to it, under Article 290(2) of the Treaty on the Functioning of the EU. This scrutiny period generally lasts two months following the adoption of the act (the precise period is specified in the basic legislative act empowering the Commission to adopt the delegated act).

Work will then focus on applying the new codes in Member States and by relevant stakeholders. Permit procedures and related documentation will need to be adapted to implement the new codes. Waste operators may have to modify their management procedures to adapt to the more stringent provisions when dealing with and shipping hazardous waste within the EU and to OECD countries.

This updated list is a significant step toward fostering a circular economy in the EU. By ensuring better classification and management of battery-related waste, the changes aim to protect human health and the environment while supporting advancements in battery recycling and innovation. This forward-looking approach not only strengthens the EU's strategic autonomy but also reinforces its commitment to sustainability, setting a strong foundation for achieving climate neutrality and driving the green transition. The collaborative effort among stakeholders and Member States will be crucial in fully implementing these changes and unlocking their potential benefits.

AN AWARD FOR GREEN INNOVATION

Fornnax Technology, one of the leading recycling equipment manufacturers, has reached a significant milestone by securing the industry's prestigious 'Green Innovation of the Year' award at the 8th Indian Cement Review Awards 2024-2025. This accolade highlights the remarkable impact of its SR-MAX2500 Primary Shredder, a unique solution that is transforming the waste processing and resource recovery in the cement industry and waste-to-energy sectors.

The SR-MAX2500 is designed to manage exceptional precision and efficiency. It excels in handling Municipal Solid Waste (MSW). Industrial and commercial waste, construction and demolition debris, wood waste, and several other types of waste. This innovation enables cement industries and waste-to-energy businesses to reduce their reliance on traditional fossil fuels, such as coal and other natural resources, and achieve sustainability goals through AFR (Alternative Fuel and Raw Material) and RDF (Refuse-Derived Fuel) plants.

Boasting a robust design and advanced technology, the SR-MAX2500 ensures high reliability and operational excellence, making it an invaluable asset for industries pursuing cost-effective and environmentally conscious solutions.

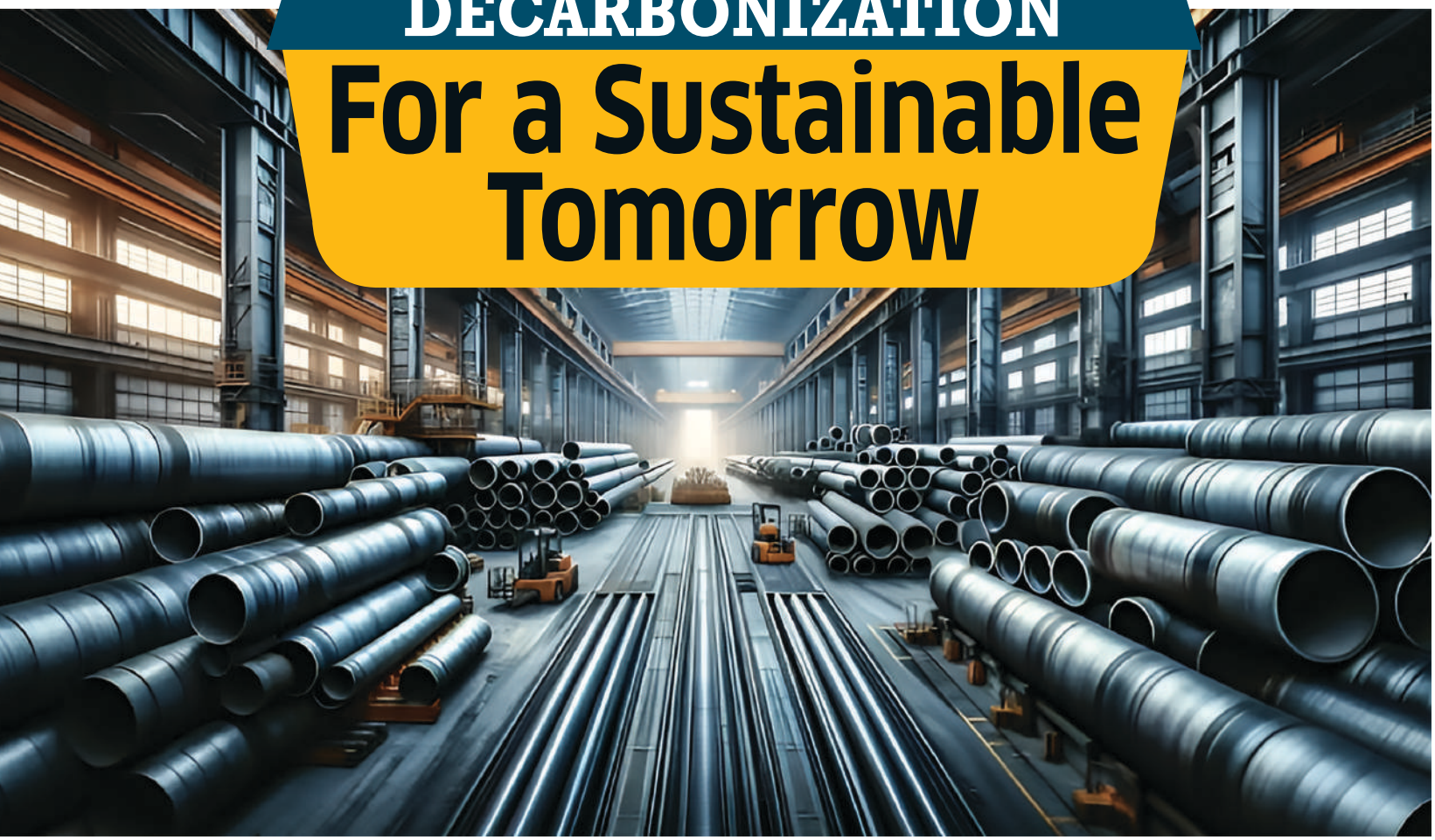
Commenting on this ocassion, Jignesh Kundaria, Director and CEO of Fornnax Technology, stated, "This award reflects our unwavering commitment to innovation and sustainability. The cement sector has long been a significant contributor to global CO2 emissions, and at Fornnax, we are dedicated to engineering solutions that address these challenges through AFR and RDF systems. The SR-MAX2500 embodies our vision of creating a greener, cleaner future."

Tailored specifically for the Indian market, the SR-MAX2500 offers tangible benefits such as enhanced efficiency, reduced downtime, and increased profitability. Its advanced features position it as a standout innovation in waste management and recycling technologies.

Sharing his aspirations, Mr. Kundaria added, "At Fornnax, our vision is to lead the recycling industry with state-of-the-art, sustainable solutions by 2030. This award is a testament to our team's relentless efforts and dedication to making a positive environmental impact. We look forward to expanding our global presence, building strategic partnerships, and continuing to deliver cutting-edge technologies that inspire change."

With this honor, Fornnax Technology cements its position as a pioneer in the recycling industry, paving the way for a sustainable and eco-friendly future.

DECARBONIZATION
For a Sustainable Tomorrow



With advancements in standardized certifications, metal grading, and innovative technologies, the steel sector is undergoing a dynamic redefinition in its grading and utilization across diverse applications. This is the first installment of a three-part series based on the JPC Report 2024, spotlights the critical role of sustainability and decarbonization in steel production

Steel is used in everything from bridges to automobiles to paper clips. It is one of the enabling materials that has resulted in unparalleled increases in standard and human development. However, the steel industry, like all other polluting economic sectors and material groupings, must decarbonize to address the climate challenge.

Because of its success as a material, worldwide crude steel production exceeds 1.9 gigatonnes, yet it produces an estimated 3 gigatonnes of CO2 emissions per year.

Steel is produced from either primary sources (extracting iron ore from nature and processing it into pure iron) or secondary sources (remelting steel scrap into new steel) or a mix of both. This secondary-source steel scrap is made up of discarded steel from manufacturing waste production as well as recovered steel from buildings, infrastructure, equipment, vehicles, and other items that have reached the end of their useful lives. The quantity of steel scrap accessible on a worldwide scale is limited by the pace of disposal by civilization. The supply of iron ore-based

steel, on the other hand, is expandable since mine activity may be expanded to meet rising steel demand.

Steel has excellent circularity properties. Whereas other materials are often downcycled at their end of life, for many applications, steel scrap can be repeatedly turned back into new steel, retaining its original properties. The magnetic properties of steel make it easy to segregate steel scrap from mixed waste streams.

India produced 118 MT of crude steel in 2021 from three major routes of production: Basic Oxygen Furnace (BOF), Electric Arc Furnace (EAF) & Induction Furnace (IF). India's steel production through BOF was 45% against the 71% global average, while the steelmaking process through the electric route (EAF+IF) was 55% as compared to the global average of around 29%. As per the COP26 agreement, India has set the target of becoming carbon neutral by 2070.

The steel industry, a hard-to-abate sector, has already become a major focus area for the government to reduce the carbon footprint of the industry. Various decarbonization strategies are being explored by many global steel producers to reduce emissions. Some of these are to enhance the efficiency of the Blast Furnace by improving the iron content of the BF burden mix, increasing the use of clean fuel injection, and utilising coke oven gas in the Blast Furnace. However, the extent of emission reduction that can be achieved by improving blast furnace efficiency is limited.

In this regard, the DRI (Direct Reduced Iron) ironmaking process can play a vital role. At present, the DRI ironmaking process utilises coal and syngas to reduce iron ore. As syngas is produced from natural gas or coal gasification, a clean coal technology, the DRI ironmaking process using syngas, which is a dominant method globally, has a lower carbon footprint than other ironmaking processes (Blast Furnace & Coal-based DRI). An EAF mill coupled with a gas-based DRI plant emits about half of the CO2 that an Integrated Steel Plant based on the BF-BOF route emits.

DEEP DECARBONISATION TECHNOLOGIES

Deep decarbonisation technologies in steel are a set of innovative approaches and processes aimed at reducing or eliminating greenhouse gas (GHG) emissions associated with steel production, which is one of the largest industrial sources of carbon dioxide (CO2) emissions. These technologies are being developed and implemented to help address the urgent need to mitigate climate change by drastically reducing carbon emissions from steel production. The technologies are briefly detailed below:

> ***Globally, crude steel production exceeds 1.9 gigatonnes, producing aound 3 gigatonnes of CO2 emissions per year***

WSA: 2022 WORLD STEEL IN FIGURES

Green Steel: It uses green hydrogen as a reductant in the DRI furnace to produce iron. The DRI is charged in an electric arc furnace that will use electricity generated from a renewable source to produce steel, making the complete steel-making process carbon neutral. Green steel technology is the most advanced in fossil-free steelmaking and is currently being developed globally. Several global players have taken the initiative to develop a technology lead over others in this arena. For example, SSAB (Svenskt Stål AB), LKAB (Luossavaara-Kiirunavaara Aktiebolag) and Vattenfall are developing Hydrogen Breakthrough Ironmaking Technology (HYBRIT) in Sweden, Salzgitter AG (German Steel maker) is developing SALCOS (Salzgitter Low CO2 Steelmaking) in Germany, ArcelorMittal Sestao (Spain) has planned to construct a green hydrogen direct reduced iron plant at Gijon, along with a new hybrid EAF, and Tata Steel Netherlands has committed to switching to green hydrogen-based steel making. Currently, these technologies are being demonstrated as a pilot project, and commercial-scale production is planned at a later stage.

Carbon Capture Utilisation & Storage (CCUS): It involves the capture of CO2 emitted from steel plants. The captured CO2 is compressed and transported by pipeline, ship, rail, or truck to be used in a range of applications or injected into deep geological formations, which can trap the CO2 for permanent storage. Currently, Arcelor Mittal Belgium, in partnership with LanzaTech, is developing Carbalyst technology; in Germany, Thyssenkrupp has developed Carbon2Chem technology; and in France, a 3D Carbon capture pilot has been developed. To capture CO2 emitted from steel, make a shot to convert it into biofuel, ammonia, urea, or another carbon-based chemical that can be sold in the market to generate value from the waste.

H2-BF: At present, globally, pulverised coal injection (PCI), oil, and natural gas are being used in combination with Coke to improve the efficiency of the BF. Although CO2 emissions are reduced by these auxiliary agents in BF, they still emit CO2. H2 Future in Austria has developed a technology to replace these auxiliary reducing agents with H2 to completely remove CO2 emissions from auxiliary reducing agents in BF. Currently, Arcelor Mittal, Voestalpine, Thyssenkrupp, Tata, and Dillinger Saarstahl are using this technology for reducing CO2 emission in the BF- route of steel making.

> ***Fossil-free steelmaking technologies are currently being demonstrated as a pilot project, and will soon be on commercial scale***

Partial replacement of PCI in BF with Biomass: Arcelor Mittal is constructing an industrial-scale demonstration plant in Gent, Belgium, to assess the viability of the replacement of coal with torrefied biomass. Reactor 1 of the plant is expected to start production by the end of 2022, and reactor 2 in 2024. When in full production, it will reduce Gent's CO2 emission by 225kt annually.

DRI-SAF-BOF: Thyssenkrupp and ArcelorMittal are working on a DRI-SAF-BOF configuration that adds a Submerged Arc Furnace (SAF) melting stage after DRI production to facilitate the use of low-grade ore in the DRI ironmaking process.

That can eliminate the requirement for high-grade iron ore in EAF for making green steel. These are some of the key decarbonization technologies in steel that are being developed and implemented to reduce GHG emissions associated with steel production and contribute to the global effort to mitigate climate change. These technologies are still in various stages of development and deployment, and their widespread adoption will require significant investments, technological advancements, and supportive policy frameworks. *(to be continued)*

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Of challenges and growth drivers

India's recycling sector is undergoing a profound transformation, propelled by rapid industrial expansion, escalating consumer demand, and a heightened awareness of environmental sustainability. These comprehensive reports delve into some of the segments of this burgeoning industry, analyzing prevailing trends, significant challenges, and promising prospects.

Tungsten recycling

EMPHASIS ON CIRCULAR ECONOMY TO DRIVE GROWTH

According to a research report by 6Wresearch, India occupies a pivotal position as a major global consumer and producer of tungsten, a critical metal renowned for its high hardness and stability at elevated temperatures. This makes it indispensable for manufacturing heavy-duty industrial tools. The demand for tungsten is anticipated to experience substantial growth in the coming years, driven primarily by the robust expansion of the automotive and infrastructure sectors.

The automotive industry, with its escalating production levels and the growing need for fuel-efficient components, accounts for a significant portion of India's tungsten consumption. Simultaneously, the rapid execution of infrastructure development projects, encompassing the construction of roads, bridges, and airports, necessitates the utilization of tungsten alloys. The metal's exceptional properties, such as strength, durability, and wear resistance, render it invaluable across various specialized industrial sectors, including aerospace and machinery manufacturing.

However, the tungsten recycling market in India faces several formidable challenges. The high cost of raw materials, which can fluctuate significantly depending on the type and grade of tungsten used, poses a substantial barrier to profitability. Additionally, a shortage of skilled personnel, particularly during peak demand periods, can lead to operational delays and reduced productivity. These factors collectively impact the overall competitiveness and operational flexibility of market players.

Despite these challenges, the long-term potential of the

Plastic waste

EFFECTIVE POLICY IMPLEMENTATION A SIGNIFICANT CHALLENGE

A report by Mordor Intelligence highlights that India contributes approximately 20% to global plastic emissions, underscoring the urgent need for effective strategies in managing plastic waste. The country's rapidly growing population and increasing affluence have caused a sharp rise in overall waste generation, particularly plastic.

India's waste management infrastructure faces significant challenges, with uncontrolled land disposal sites vastly outnumbering sanitary landfills. This disparity highlights the inadequacies in current waste management practices and the need for urgent reforms. The official waste generation rate, while substantial, is believed to be understated, and official statistics often overlook the open burning of uncollected waste and the contributions of the informal recycling sector.

The Indian government has implemented a series of initiatives to combat the plastic waste crisis, including bans on specific single-use plastic items and nationwide campaigns promoting recycling. The Plastic Waste Management Rules and the Swachh Bharat Abhiyan are pivotal components of this strategy, focusing on reducing plastic consumption and improving cleanliness and sanitation standards across the country. However, the effective enforcement of these policies remains a significant challenge.

To bolster plastic waste collection and segregation, the government has introduced various initiatives under the Swachh Bharat Abhiyan, including door-to-door collection, community bins, and dedicated plastic waste collection

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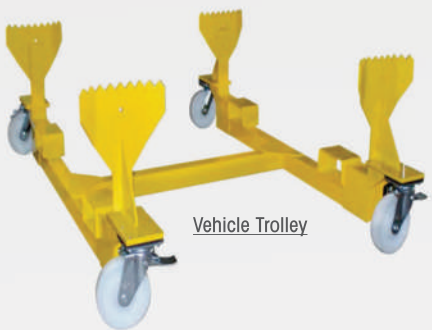
Dismantling Tilting Ramp


ELV Drainage System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Aluminium

DRIVEN BY SUSTAINABILITY AND DEMAND

The aluminium recycling market in India is experiencing substantial growth. A research report published by Valuates Reports says, “This market is driven by the aluminium industry's need for more sustainable production methods and the increasing demand for recycled aluminium as a raw material.”

The overall recycling market in India is poised for significant growth in the coming years, driven by a confluence of economic, environmental, and regulatory factors. The government's unwavering commitment to promoting sustainable waste management practices, coupled with increasing industry participation and technological advancements, will be crucial in realizing the sector's full potential.

However, several challenges remain, including high raw material costs, skill shortages, price fluctuations, and logistical complexities. Addressing these challenges through strategic investments in infrastructure, technology, and human capital will be essential for ensuring the long-term sustainability and competitiveness of the Indian recycling industry.

Consolidating recycling operations, improving scrap sorting technology, and adopting advanced metal treatment processes are critical for enhancing operational efficiency and maximizing resource recovery. Urban mining, through the demolition of old buildings and infrastructure, presents new opportunities for sourcing valuable scrap materials. Collaboration with secondary smelters and alloy producers can streamline the recycling processes and create a more integrated and efficient value chain.

India's recycling sector is at a pivotal juncture, poised for transformative growth and innovation. The government's proactive policies, coupled with increasing industry participation and technological advancements, are creating a conducive environment for sustainable waste management practices. While challenges persist, the opportunities for economic growth, environmental sustainability, and social development are immense. By embracing circular economy principles and investing in cutting-edge recycling technologies, India can emerge as a global leader in sustainable waste management and resource recovery.

Indian Scrap Scenario

EXPERIENCING RAPID GROWTH

Asia Pacific dominates the global scrap metal recycling market, holding an estimated share of 41.2% in 2025. This dominance is attributed to robust government policies, such as the National Non-Ferrous Metal Scrap Recycling Framework, which promote recycling and waste management. Countries like China, India, and Japan generate substantial volumes of scrap metal from their extensive manufacturing and construction activities.

India's scrap metal recycling market is experiencing rapid growth, driven by the burgeoning automotive sector and the implementation of large-scale infrastructure projects. Local players, collaborate with global companies to adopt best practices and enhance operational efficiency.

Rising scrap metal prices and environmental concerns fuel the market's growth. As global production and consumption of metals continue to rise, recycling scrap metal provides a sustainable and economically viable option for procuring raw materials.

E-waste

CHALLENGES IN DIGITALIZATION

According to a research report by UNCTAD, India experienced an alarming 163% surge in electronic waste generation between 2010 and 2022. The rapid digitalization of the economy has led to a dramatic increase in the production and disposal of electronic devices, posing significant environmental and health risks. A substantial portion of this e-waste is processed in informal settings, particularly in developing nations, where it is often handled without adequate safety measures.

Data from the Ministry of Environment, Forest, and Climate Change (MoEF) reveals that recycling rates are gradually improving, albeit from a low base. The Gandhian E-Waste Management System project, launched in 2021, aims to enhance e-waste management through the development of robust collection, transfer, and storage infrastructure in major Indian cities. The Central Pollution Control Board (CPCB) estimates that e-waste generation in India will reach 5.2 million metric tons by 2025, underscoring the urgency of addressing this critical issue.

The government is also conducting capacity-building activities, including training sessions, to promote awareness of proper e-waste disposal methods and encourage responsible recycling practices. These initiatives are essential for fostering a culture of responsible e-waste management and mitigating the adverse impacts of electronic waste on the environment and public health.

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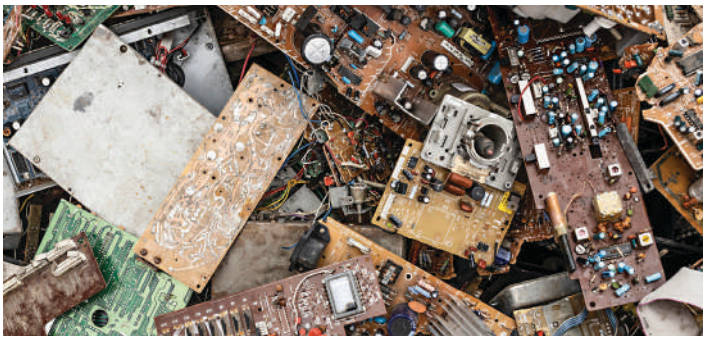
E_WASTE RECYCLING

India Moves Toward Sustainability with New Initiative



CSIR-National Metallurgical Laboratory (NML), Jamshedpur, has entered a landmark agreement with M/s Eyantram Waste Management Private Limited, Visakhapatnam, to establish an e-waste recycling plant. The facility will process waste printed circuit boards (PCBs) to extract valuable metals like gold, copper, and aluminum through a sustainable technology transfer.

The agreement will enable Eyantram to implement the "Zero Waste" concept, reducing environmental pressure while organizing the unregulated waste collection and disposal sectors. This eco-friendly approach promises cleaner surroundings, employment for youth, and organized waste management systems, benefiting municipal units.

Led by Dr. Sandip Ghosh Chowdhury, Director of CSIR-NML, and a team of distinguished scientists, the technology transfer emphasizes environmental protection and economic growth. This initiative is expected to reduce India's ecological footprint, recover crucial resources, and bolster the country's commitment to tackling e-waste challenges on a national scale.

The e-waste recycling sector presents significant opportunities for India's economic development, with the potential for scaling up across industries and creating awareness for startups. Strict safety protocols to enhance the recycling efficiency.

INTERNATIONAL POLICY

Provisional Anti-Dumping Duties on Steel Coils

The European Commission (EC) has released preliminary findings from its anti-dumping investigation into hot rolled coils (HRC) imported from Egypt, India, Japan, and Vietnam. Temporary anti-dumping duties, effective April 7, are proposed for Egypt, Japan, and Vietnam, ranging from 6.9% to 33%.

Egypt, including producer Ezz Steel Company, faces a 15.6% duty. Japanese companies such as Nippon Steel face a 33% duty, while Daido Steel and JFE Steel face 32%. Tokyo Steel receives the lowest duty of 6.9%. Vietnam's Formosa Ha Tinh Steel Corporation and

others face a 12.1% duty, though Hoa Phat is exempt. Notably, the investigation found no dumping of HRC imports from India. The EC had previously launched a 9-month registration process to enable retroactive anti-dumping duties.

The products under investigation fall under various customs codes, such as 7208 10 00 and 7208 25 00, among others, indicating a broad range of affected HRC categories.

SCRAP EXPORTS

Germany Hit a Low Record In 2024

Germany's exports of ferrous scrap decreased by 11% in 2024, totaling 7.1 million tons—the lowest level since recordkeeping began in 2006, according to Destatis data reported by Kallanish. Export revenues dropped to €3.9 billion from €4.2 billion in 2023. The previous record low was set in 2009 with 7.48 million tons exported.

India witnessed the steepest decline in scrap shipments from Germany, dropping by 300 thousand tons to 111 thousand tons, pushing it out of the top ten export destinations. Significant reductions were also noted in supplies to Italy, the Netherlands, and Turkey.

Exports for 2023 had already fallen to 7.61 million tons, marking a 3% decline compared to 2022—also the lowest export figures since the economic crisis of 2009.

In a position paper, the German Steel Scrap Association (BDSV) and the Association of German Metal Traders and Processors (VDM) emphasized urgent measures for the federal government. They urged reductions in electricity taxes and fees to minimum EU levels, accelerated renewable energy expansion, and temporary industry support mechanisms to alleviate challenges posed by high electricity costs and regulatory barriers.

Despite Germany's increase in steel production by 5.2% to 37.23 million tons in 2024, demand for scrap remained below supply due to slow electrification in the steel industry. Pig iron and hot-rolled steel production also grew by 2.9% and 3% year-on-year, respectively, though total smelting volumes have stayed below 40 million tons for three years, indicating recession levels, WVStahl noted.

SUSTAINABILITY

Financing Projects with Carbon Credit Services

Amazon (NASDAQ: AMZN) has introduced a carbon credit service via its Sustainability Exchange, granting qualified companies access to high-quality, science-backed carbon credits. This initiative supports suppliers, business customers, and Climate Pledge signatories in advancing sustainability efforts.

Aligned with its goal to achieve net-zero carbon emissions by 2040, Amazon is transitioning to carbon-free energy, electrifying its delivery fleet, and enhancing energy efficiency. Moreover, the company is actively investing in scaling carbon removal projects and directing private-sector funds toward critical environmental initiatives.

The United Nations Intergovernmental Panel on Climate Change (IPCC) underscores the urgency of high-quality carbon credits for combating climate change by curbing deforestation, restoring forests, and removing existing emissions from the atmosphere. Carbon credits are essential for financing impactful projects, promoting economic growth, and delivering tangible climate benefits.

To tackle access challenges, Amazon's Sustainability Exchange provides a resource hub for decarbonization strategies and allows eligible companies to invest in vetted carbon credits. Participants must have net-zero targets covering Scope 1, 2, and 3 emissions, publicly disclose greenhouse gas emissions, and adopt science-based decarbonization plans.

Kara Hurst, Amazon's Chief Sustainability Officer, highlighted the critical role of nature-based solutions, such as reversing deforestation, in mitigating climate change. Conservation International and the Environmental Defense Fund (EDF) commended Amazon for driving corporate climate action.

With this, Amazon aims to empower businesses to protect the environment and achieving sustainability goals.

SCRAP

Modern Scrap Metal Processing Facility

Naval Dockyard, a key establishment under the Eastern Naval Command, has commissioned an advanced scrap metal processing facility in Visakhapatnam. This state-of-the-art facility aims to enhance the segregation and processing of metal scrap, significantly reducing the environmental impact of the repair and maintenance work of warships, submarines, and auxiliary vessels.

Equipped with modern features such as a jib crane, the facility prioritizes worker safety during operations. This machinery enables efficient separation of ferrous and non-ferrous metals, followed by compacting the materials into dense bales. The compacted metal is easier to handle, transport, and store, streamlining the overall process.

This initiative underscores the Naval Dockyard's commitment to sustainability while maintaining operational efficiency. By reducing its carbon footprint, the dockyard not only advances eco-friendly practices but also strengthens its capability to support the upkeep and readiness of the naval fleet. The new facility reflects a forward-looking approach, merging technological innovation with environmental responsibility.

SUSTAINABILITY

Saudi Arabia's First Direct Air Capture Facility

Aramco, the global energy and chemicals giant, has partnered with Siemens Energy to inaugurate Saudi Arabia's first direct air capture (DAC) technology testing unit. This facility, capable of capturing 12 tons of atmospheric carbon dioxide annually, serves as a research hub for advancing DAC technologies.

The site focuses on creating next-generation carbon capture materials tailored for Saudi Arabia's climate. It aims to deliver meaningful climate outcomes while exploring cost-reduction pathways to scale DAC technologies across the region. Both companies aspire to achieve large-scale DAC deployments in the future.

This launch is part of Aramco's comprehensive sustainability strategy that targets emissions reduction and residual CO2 removal. Aramco has committed to achieving Scope 1 and Scope 2 net-zero emissions across its wholly-owned operations by 2050. Additionally, the company's plans include the creation of a Carbon Capture and Storage (CCS) hub in Jubail, Saudi Arabia, in partnership with Linde and SLB. Phase One of the Jubail hub is projected to capture nine million tonnes of CO2 from Aramco's gas plants and other industrial sources.

Ali A. Al-Meshari, Aramco's Senior Vice President of Technology Oversight and Coordination, underscored the importance of scaling DAC systems in Saudi Arabia. He also highlighted the added value of captured CO2, which can be repurposed to produce sustainable chemicals and fuels.

PLASTIC RECYCLING

Fresh Investments in Bengal

West Bengal is set to attract substantial investments in plastic recycling due to stricter extended producer responsibility (EPR) regulations and the growing demand for sustainable solutions. Lalit Agarwal, president of the Indian Plastics Federation (IPF), stated that the union government's EPR norms, requiring 25% recycled plastic in packaging from April 1, 2025, will boost recycling projects and the circular economy.

Agarwal predicted a fresh investment cycle in plastic recycling that could rival investments in plastic processing. West Bengal plans a Rs 3,000 crore capital expenditure for plastic processing units in the coming years. Recycling projects worth Rs 450 crore are already underway, according to IPF National Advisory Board chairman Alok Tibrewal.

British International Investment (BII) recently signed an agreement with Magpet Polymers in Kolkata, providing Rs 205 crore (USD 24 million) for expanding Magpet's PET bottle recycling facility in Kharagpur.

Recently, the 10th edition of INDPLAS'25, IPF's international plastics exhibition, kicked off. This four-day B2B event is the largest in eastern India and features 400 exhibitors and an estimated one lakh visitors, including foreign delegates.

An Invest Bengal Seminar also showcased the state's industrial potential, incentives, infrastructure development, and skilled workforce to position West Bengal as a hub for plastics manufacturing.

SHIP RECYCLING

Demolition Yard in Egypt

Maersk has signed a memorandum of understanding in Egypt to explore green ship recycling in the Middle Eastern nation as part of the government's bid to be less reliant on imported scrap metal.

The planned demolition yard will be created at Damietta port to the west of Port Said on the Mediterranean and will be compliant with the incoming Hong Kong Convention on improved ship recycling conditions.

The Egyptian site will cover some 155,000 sq m and will be capable of handling ships of up to 230 m in length. Other Egyptian ship recycling sites are also being discussed.

Maersk has a history of helping nations develop greener ship recycling sites. For instance, when it took over P&O Nedlloyd 20 years ago, it took on the responsibility of developing what was then China's leading demo yard.

CONSTRUCTION WASTE

MoU Signed to Design Sustainable Machinery

Construction equipment major Schwing Stetter India has partnered with IIT Madras to drive sustainable innovations in the construction industry through a memorandum of understanding (MoU). The company will become a platinum member of the Technologies for Low Carbon Lean Concrete (TLC2) program and join the Industry Advisory Board of IIT Madras' Centre of Excellence.

Schwing Stetter aims to create sustainable machinery to recycle concrete and construction waste, supporting IIT Madras' research into practical applications. VG Sakthikumar, CMD, highlighted this collaboration as a win-win, combining Schwing Stetter's mechanical expertise with IIT Madras' academic knowledge. The partnership includes a Rs 75 lakh grant over three years, with the first tranche already disbursed.

Focusing on high-carbon footprint industries like cement and steel, the collaboration aims to promote the recycling of resources such as quarry stones and aggregates, which burden solid waste management. However, while the Indian government encourages 25% use of recycled aggregates in construction, implementation lacks regulation and incentives.

Previously, both organizations conducted a study with Chennai Metro on reusing construction and demolition waste aggregates for concrete production, publishing a report on their findings. The partnership also emphasizes energy-efficient, eco-friendly construction techniques and innovation through academic-industry collaboration.

Schwing Stetter engineers will benefit from skill development training with IIT Madras faculty and engage in various collaborative projects. This initiative addresses sustainability challenges while fostering technological advancements in the construction sector, underscoring the importance of integrating recycling practices and green innovation.

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SUSTAINABILITY

Pilot Projects on Green Hydrogen

The Government of India, under the National Green Hydrogen Mission, has launched five pilot projects to introduce hydrogen-powered buses and trucks. The Ministry of New and Renewable Energy (MNRE) invited proposals for hydrogen vehicles, routes, and refueling stations. Following a detailed evaluation, MNRE has sanctioned 37 vehicles, comprising 15 hydrogen fuel-cell-based and 22 hydrogen internal combustion engine-based vehicles, along with nine hydrogen refueling stations.

The pilot projects will cover ten routes across India, including Greater Noida–Delhi–Agra, Pune–Mumbai, and Thiruvananthapuram–Kochi. Companies such as TATA Motors, Reliance Industries, NTPC, Ashok Leyland, BPCL, HPCL, and IOCL are involved in the projects, which aim to establish the safe and efficient use of hydrogen as a fuel and validate its technical and economic viability. The government has allocated ₹ 208 crores in financial support, with commissioning expected within 18–24 months.

These pilot initiatives seek to develop commercially viable technologies for hydrogen-powered transport and infrastructure, including refueling stations. The trials will assess hydrogen vehicles' feasibility, performance, and safety under real-world conditions. The success of these projects could pave the way for scaling up hydrogen-powered buses and trucks and associated infrastructure.

The National Green Hydrogen Mission, launched on January 4, 2023, with an outlay of ₹ 9,744 crores up to FY 2029–30, represents India's commitment to clean energy transition and self-reliance. It aims to decarbonize the economy, reduce reliance on fossil fuel imports, and establish India as a global leader in green hydrogen technologies and markets, inspiring sustainable energy solutions worldwide.

BATTERY RECYCLING

Porsche to Establish High-Voltage Network

Porsche is advancing its battery recycling strategy through a pilot project divided into three phases. The first phase involves shredding high-voltage batteries from development vehicles and processing them into "black mass," which contains raw materials like nickel, cobalt, manganese, and lithium. Porsche reports that approximately 65 tonnes of black mass have been produced so far.

In the second phase, the black mass is refined and separated into individual raw materials. Porsche emphasizes the importance of the quality and purity of recycled materials to produce high-quality batteries for electric vehicles. In the final phase, Porsche plans to manufacture high-voltage battery cells containing recycled materials and test their application in Porsche vehicles. This initiative reflects the company's commitment to a circular economy where raw materials from decommissioned batteries are recovered, processed, and reused.

Porsche aims to establish a European closed-loop battery material cycle and prepare for future EU regulations set to take effect by 2031. Barbara Frenkel, Porsche's Executive Board Member for Procurement, highlights that the circular economy is a core pillar of the company's sustainability strategy and a step towards reducing dependence on unstable raw material markets.

It has also deepened its involvement in battery production by acquiring Varta, investing in the battery recycling startup Cylib, and partnering with Webasto for recycling cooperation.

APPOINTMENT

New CEO to Spearhead Vedanta's Aluminium Division

Vedanta Ltd has appointed Rajiv Kumar as the Chief Executive Officer (CEO) of its aluminium business for a three-year term starting March 26, 2025. This appointment fills the vacancy left since John Slaven's departure in September last year.

Kumar transitions to Vedanta from Tata Steel, where he served as Vice President of Operations at the Kalinganagar facility. With over three decades in the steel and mining industries, his expertise is expected to drive Vedanta Aluminium's strategic initiatives.

Also read: Vedanta, NABARD unite to transform rural livelihoods in Odisha

In his new role, Kumar will lead the overall strategy for the aluminium division, focusing on developing strategic alliances, fostering innovation, and advancing digitalization efforts. Vedanta emphasized that his leadership will be pivotal in unlocking long-term value for shareholders and stakeholders.

This leadership change aligns with Vedanta's broader strategy to demerge its aluminium operations into an independent entity, aiming to enhance operational focus and shareholder value.

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RECYCLING

India Will Hit $3 Trillion by 2045

The Indian recycling industry is projected to reach a staggering $3 trillion within the next two decades, as shared by Ved Prakash Mishra, Joint Secretary of the Ministry of Environment, Forest and Climate Change (MoEF&CC). Speaking at the Global Symposium on Resource Efficiency and Circular Economy, jointly organized by RECEIC, FICCI, and MoEF&CC, Mishra emphasized the urgent need to transition to a circular economy to address critical environmental and economic challenges.

Mishra stressed that the traditional "take, make, dispose" model is no longer sustainable, advocating for the adoption of practices that enable resource efficiency. He highlighted that most materials manufactured today are recyclable in some form, and even non-recyclable materials like certain plastics can be utilized for energy recovery and fuel production.

India has already implemented Extended Producer Responsibility (EPR) policies in sectors such as plastic, e-waste, batteries, and used oil, aiming to hold producers accountable for the lifecycle of their products. Mishra added that more such policies are in the pipeline, signaling India's commitment to fostering sustainable practices.

Manish Sharma, Chair of the RECEIC Steering Committee, emphasized the importance of driving resource efficiency and energy security through a well-executed energy transition. Sharma stated that RECEIC aims to enable actions addressing these challenges today, reinforcing a collective responsibility toward a sustainable future.

The symposium underlined the significance of collaboration between industry leaders, policymakers, and stakeholders in achieving a circular economy. India is poised to lead the way in creating an environmentally sustainable and economically thriving recycling industry. This forward-looking approach reflects India's dedication to addressing global sustainability challenges and leveraging the potential of its recycling sector.

PRODUCTION LINKED INCENTIVE SCHEME

The 14-Sector Basket Gets Rs 2 Lakh Crore Outlay

Since its launch in 2020, the Production Linked Incentive (PLI) scheme has been expanded to 14 sectors with a total outlay of Rs 1.97 lakh crore. However, only Rs 14,020 crore has been disbursed to units in 10 sectors so far. The government anticipates a significant increase in disbursements in the coming year as more eligible units commence production.

"Projects are implemented over a two-to-three-year period, depending on the nature of manufacturing. Claims are usually made after the first year of production. Most projects are at the implementation stage and will be filing incentive claims in due course," the Ministry of Commerce and Industry said in a statement.

Lately, the Parliamentary Panel has acknowledged the impact of the PLI scheme on manufacturing and recommended its expansion to defence manufacturing, aerospace, and ship containers.

The government has informed the Standing Committee on Commerce that the PLI scheme for the leather and footwear sector is currently at the draft Cabinet note stage. The scheme, with an allocation of approximately Rs 2,600 crore, aims to boost domestic manufacturing and exports.

E-WASTE

Casio Launches CSR Campaign in North

Casio India Co. Pvt. Ltd. has launched a Corporate Social Responsibility (CSR) campaign titled "Recycle Responsibly" across Delhi NCR to address the pressing issue of electronic waste (e-waste). India, the world's third-largest e-waste generator, produces over 3.2 million metric tonnes annually, much of which is processed informally under hazardous conditions.

Launched on March 25, 2025, and concluding on April 7, the campaign introduces seven mobile e-waste collection vans. These specially equipped vehicles traverse residential areas, marketplaces, offices, and schools, providing convenient recycling options for citizens in Delhi, Gurugram, Noida, Ghaziabad, Faridabad, and Greater Noida. Citizens can also schedule e-waste pick-ups by calling +91-120-699-3119.

Akira Watanabe, Director of Casio India, emphasized the initiative's focus on educating and empowering communities to adopt responsible recycling practices. The campaign aligns with the Government of India's E-Waste Management Rules (2016, amended) and promotes the 'LiFE' movement for sustainable consumption.

In partnership with SHEOWS NGO and Allied Waste Solutions Pvt. Ltd. (AWS), the initiative ensures proper recycling through certified processes. It also aims to integrate informal workers into formal systems via training and collaboration.

The campaign accepts various e-waste items and hosts educational sessions in Resident Welfare Associations (RWAs) and commercial areas to highlight the risks of improper disposal. Participants are rewarded with tokens of appreciation.

Casio India's campaign aspires to inspire lasting behavioral change, fostering a community-driven culture of sustainable e-waste disposal.

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3	Panchratna Aluminium Pvt. Ltd.	Chhatral	Gujarat	Mr. Parth Patel, Director
4	Mirtunjai Udyog	Rourkela	Odisha	Mr. Vikram Kumar Jaiswal, Proprietor
5	Jay Ispat Traders	Hawrah	West Bengal	Mr. Ashok Agarwal, Partner
6	Mitra S. K. Pvt. Ltd.	Kolkata	West Bangal	Mr. Sandip Datta, Executive Director
7	Elite corporation	Bhavnagar	Gujarart	Mr. Usmangani Farukbhai Galdhera, Proprietor
8	JSK Industries Pvt. Ltd.	Mumbai	Maharashtra	Mr. Anish Dinesh Shah, Director
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	INTERNATIONAL			
1	Tareeq Al Zain Metal TRLLC	Al Mazar	UAE	Ms. Shylaja Bano, Manager

MRAI is an umbrella organization having under its wings most of the National and Regional Trade Associations and almost all of the international trade associations related and associated with recycling. Whether it is leading National Associations such as CII and FICCI or International Organizations such as Bureau of International Recycling , BIR and Institute of Scrap Recycling Industries , ISRI, MRAI works shoulder to shoulder in promoting Responsible recycling across industries. MRAI's collective strength comprises over 20,000 small, medium and large enterprises, directly and indirectly employing 25 lakh people.

MRAI offers unparalleled opportunities to develop National and International business contacts. Join MRAI to get access to Members Directory, an essential networking and information tool featuring details about potential organizations that includes suppliers and customers all over the world.

MRAI extensive network has become an influential source of information for public authorities, the media, and other industry sectors. Representing its member's interests, MRAI maintains contact with other national and international bodies FICCI, ASSOCHAM, CII, BIR, BMR, ISRI, advising them on the formulation of appropriate legislation and the promotion of a more competitive Recycling Industry.

MRAI liaison with Ministry of Steel, Ministry of Commerce, Ministry of Finance, Ministry of Mines, Ministry of Environment and Forest, Ministry of Shipping, Customs and took up the problems of its Members at various State Government and Central Government level.

MRAI provides the following services to its members:

- Promoting all types of recycling in India.
- Pursuing with GOI to obtain official industry status for the Recycling industry in India.
- Providing our Members, a proper forum to discuss the various issues faced by the Recycling Community.
- Representing the Government for abolishing the import duties levied on the scrap material.
- Provides Membership Certificates to its Members.
- Distributing a complimentary Magazine to members.

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Indian Import of Non-Ferrous Scrap

(Updated on 31/3/2025)

		Quantity in Thousands		Values in Rs. Lacs	
HS Code	**Description**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**
740400	COPPER WASTE AND SCRAP	27,994.76	2,69,992.80	1,46,130.49	14,49,868.62
760200	ALUMINIUM WASTE AND SCRAP	1,46,743.35	13,91,585.60	2,74,151.08	25,23,652.43
790200	ZINC WASTE AND SCRAP	7,146.86	58,781.12	13,286.48	1,04,925.79
780200	LEAD WASTE AND SCRAP	14,972.23	1,31,259.61	24,874.90	2,04,296.80
750300	NICKEL WASTE AND SCRAP	535.56	3,905.89	3,509.95	29,714.27
	TOTAL	**1,97,392.76**	**18,55,525.02**	**4,61,952.90**	**43,12,457.91**

Indian Import of Ferrous Scrap

(Updated on 31/3/2025)

		Quantity in Thousands		Values in Rs. Lacs	
HS CODE	**DESCRIPTION**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**
720421	WASTE AND SCRAP OF STAINLESS STEEL	1,23,000.71	9,27,382.44	1,46,276.62	10,71,519.46
720410	WASTE AND SCRAP OF CAST IRON	16,129.12	1,68,609.20	6,002.98	60,864.54
720429	WASTE AND SCRAP OF OTHER ALLOY STEEL	16,259.53	1,31,556.40	8,906.55	75,331.32
720430	WASTE AND SCRAP OF TINNED IRON OR STEEL	633.30	1,802.98	164.72	445.18
720449	OTHER WASTE AND SCRAP (HMS,SHREDDED ETC.)	6,11,222.36	53,47,392.17	2,10,508.15	18,90,344.66
720450	REMELTING SCRAP INGOTS	-	-	-	-
	TOTAL	**7,67,245.02**	**65,76,743.19**	**3,71,859.02**	**30,98,505.16**

Indian Import of Paper Scrap

(Updated on 31/3/2025)

		Quantity in Thousands		Values in Rs. Lacs	
HS CODE	**DESCRIPTION**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**
47079000	OTHR INCL UNSORTED WASTE AND SCRAP	2,23,454.38	19,73,287.13	37,549.82	3,20,859.45
47071000	WSTE AND SCRP OF UNBLECHD KRAFT PAPR OR PAPRBORD OR CORGTD PAPR/PAPRBORD	2,25,365.43	16,60,514.74	41,391.55	3,09,067.70
	TOTAL	**4,48,819.81**	**36,33,801.87**	**78,941.37**	**6,29,927.15**

Indian Import of Plastic Scrap

(Updated on 31/3/2025)

		Quantity in Thousands		Values in Rs. Lacs	
HS CODE	**DESCRIPTION**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**
39011010	LINEAR LOW DENSITY POLYETHYLENE (LLDPE)	11,619.27	1,69,936.78	9,429.24	1,42,953.89
39012000	POLYETHYLENE HVNG A SPCFC GRVTY 0.94 /MORE	85,259.96	9,23,013.21	69,327.75	7,84,614.73
	TOTAL	**96,879.23**	**10,92,949.99**	**78,756.99**	**9,27,568.62**

Indian Import of Used Rubber Tyre Scrap

(Updated on 31/3/2025)

		Quantity in Thousands		Values in Rs. Lacs	
HS CODE	**DESCRIPTION**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**
400400	WASTE,PARINGS AND SCRAP OF RUBR(BESIDES HARDRUBR) AND PWDR 9 GRNLS OBTAINED THEREFROM	1,63,561.98	13,72,396.86	16,137.88	1,35,153.17
	TOTAL	**1,63,561.98**	**13,72,396.86**	**16,137.88**	**1,35,153.17**

Source: *Ministry of Commerce Export Import Data Bank*

Indian Export of Non-Ferrous Scrap

(Updated on 31/3/2025)

		Quantity in Thousands		Values in Rs. Lacs	
HS CODE	**DESCRIPTION**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**	**DEC 2024 (F)**	**APR-DEC 2024**
740400	COPPER WASTE AND SCRAP	4,189.24	14,313.12	20,715.54	83,171.89
760200	ALUMINIUM WASTE AND SCRAP	815.52	8,892.93	1,534.12	15,685.31
790200	ZINC WASTE AND SCRAP	0.06	3.19	0.02	25.43
780200	LEAD WASTE AND SCRAP		0.00		0.15
750300	NICKEL WASTE AND SCRAP	223.24	1,919.17	2,574.75	20,478.70
	TOTAL	**5,228.06**	**25,128.41**	**24,824.43**	**1,19,361.48**

Indian Export of Ferrous Scrap

(Updated on 31/3/2025)

		Quantity in Thousands		Values in Rs. Lacs	
HS Code	**Description**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**
720421	WASTE AND SCRAP OF STAINLESS STEEL	219.12	1,412.84	556.47	3,770.79
720410	WASTE AND SCRAP OF CAST IRON	501.13	2,269.20	221.13	949.73
720429	WASTE AND SCRAP OF OTHER ALLOY STEEL	1.50	514.76	0.92	1,092.16
720430	WASTE AND SCRAP OF TINNED IRON OR STEEL	_	74.26	-	26.01
720449	OTHER WASTE AND SCRAP (HMS,SHREDDED ETC.)	34.65	500.03	95.25	840.92
720450	REMELTING SCRAP INGOTS	-	0.05	-	0.82
	TOTAL	**756.40**	**4,771.14**	**873.77**	**6,680.43**

Indian Export of Paper Scrap

(Updated on 31/3/2025)

		Quantity in Thousands		Values in Rs. Lacs	
HS CODE	**DESCRIPTION**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**
47079000	OTHR INCL UNSORTED WASTE AND SCRAP	0.06	29.28	0.17	15.49
47071000	WSTE AND SCRP OF UNBLECHD KRAFT PAPR OR PAPRBORD OR CORGTD PAPR/PAPRBORD	0.43	30.62	0.26	14.28
	TOTAL	**0.49**	**59.90**	**0.43**	**29.77**

Indian Export of Plastic Scrap

(Updated on 31/3/2025)

		Quantity in Thousands		Values in Rs. Lacs	
HS CODE	**DESCRIPTION**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**
39011010	LINEAR LOW DENSITY POLYETHYLENE (LLDPE)	4,572.11	44,428.72	4,259.39	40,063.05
39012000	POLYETHYLENE HVNG A SPCFC GRVTY 0.94 /MORE	12,723.39	1,15,733.17	10,520.86	93,984.54
	TOTAL	**17,295.50**	**1,60,161.89**	**14,780.25**	**1,34,047.59**

Indian Export of Used Rubber Tyre Scrap

(Updated on 31/3/2025)

		Quantity in Thousands		Values in Rs. Lacs	
HS CODE	**DESCRIPTION**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**	**DEC 2024 (F)**	**APR-DEC 2024 (F)**
400400	WASTE,PARINGS AND SCRAP OF RUBR(BESIDES HARDRUBR) AND PWDR 9 GRNLS OBTAINED THEREFROM	375.23	4,585.29	222.40	2,233.23
	TOTAL	**375.23**	**4,585.29**	**222.40**	**2,233.23**

Source: *Ministry of Commerce Export Import Data Bank*

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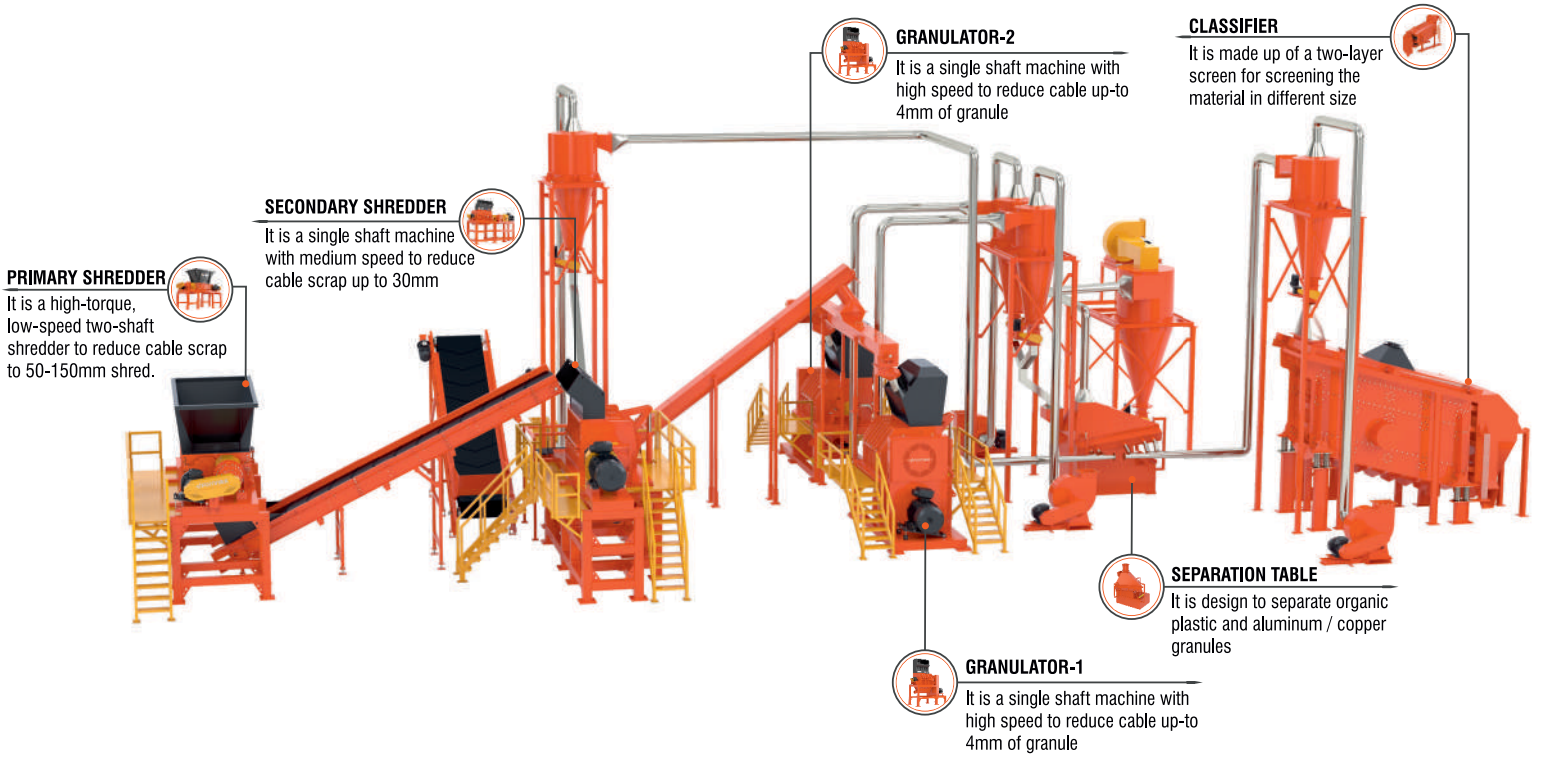

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