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Confederation of Indian Industry

Circular Economy Practice in India

Three case studies

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Circular Economy Practice in India

Three case studies

Contents

Executive summary

The practice of the concepts of circular economy always existed simply because resources were scarce, and extraction was possible only on a small scale with human labour providing the energy. However, the advent of large machines and electricity about a hundred years ago, made it possible to expand the scale of extraction and resource-use to a massive level all over the world.

India's target to become a five trillion-dollar economy, will be realized by expanded manufacturing and services which depend upon material resources and energy, both of which are drawn from the earth and finite. Moreover, inefficiencies in resource use also leads to undesirable impacts. A circular economy aims at maximizing the value and utility of resources and energy within production systems, through a product's life cycle, based on the premise that natural resources are limited and that products at their end of life may retain some value.

Circular economy practice has two goals:

- Minimizing raw material extraction from the earth
- Minimizing what goes to dumps or landfill or to 'waste'.

In India, and in many parts of the globe, much work on circular economy focuses on the second goal, and addresses recycling and waste management, both of which are necessary. However, if this is the only focus, then what remains unexploited is the large potential for change through upstream circular strategies such as design for end-of-life, product life extension and product as a service. Here, there is a leadership role for large companies in India in bringing best practices and adopting long-term strategies to conserve resources via circular models.

The central point of this report, therefore, is to show how these basic circularity strategies, meeting both the goals of a circular economy, are being practiced in India. Three case studies from Siemens, Tata Steel and Volvo Construction Equipment provide a firsthand view and identify what factors motivated their adoption. These varied from visionary thinking by CEOs to new company policies, and a search for long-term solutions to common problems. Together with serving customer needs, adoption of these strategies, at the very minimum, added value to the business, reduced natural resource consumption and prevented GHG emissions.

These companies have pioneered on-ground rollouts and carried their SME vendors along with them, providing training and hand-holding. This one action alone can serve the important need to increase awareness among smaller companies and businesses, especially in India where they operate in large numbers.

If the end-market for a stream of secondary material exists, then material will move though that value chain, decreasing waste in landfill or for waste-to-energy. This allows the value of that material/natural resource to be realised and conserved. In India, as in other countries of the Global South, waste collection and aggregation activities are dominated by the informal sector with extensive networks already in place. We are fortunate to still have systems, processes, and markets which enable circular economy business models such as repair, refurbishment and reuse. The informal network and components of the massive trade in secondary materials are not systematically named, valued in dollar terms, or identified using any defined terminology; however, the entire system offers a tremendous opportunity for structuring and scaling by building on what exists, with the added availability of digital technologies to ease the movement, trading and channelling of material to end-markets. Opportunities on a larger scale than the informal one can be similarly identified and worked upon.

In India, enabling policy has been in place for a few years – some tenets related to resource efficiency and circular economy became part of India's policy framework quite early on. The Government of India enacted the National Environment Policy[1] in 2006, which emphasized sustainable development and was intended to mainstream environmental concerns in all development activities. It addressed resource efficiency, waste minimization, and recycling, but did not explicitly use the term circular economy. Later, in 2016, the waste management rules under the Environment (Protection) Act, 1986, were revised, introducing the concept of Extended Producer Responsibility (EPR) into policy, and in a sense, establishing the foundation of circular economy in India. Since then, a number of EPR schemes for different waste streams have been notified.

Academic publications and research in this area are increasing albeit with a focus on waste and its management in the textiles, construction, sectors, and urban water and wastewater systems. As an important stakeholder in the business sphere, the Confederation of Indian Industry's activities in circular economy and resource efficiency began in 2018, and has covered materials such as pulp-paper, iron-steel, cement, and includes an ongoing initiative on circularity of plastic packaging.

Enabled by digital technology, tools for metrics and better means of communication, adopting circular principles is not difficult, out of reach or impractical. It is the way to address our resource-related, and business-related challenges while providing value for business, the economy, society and the environment.

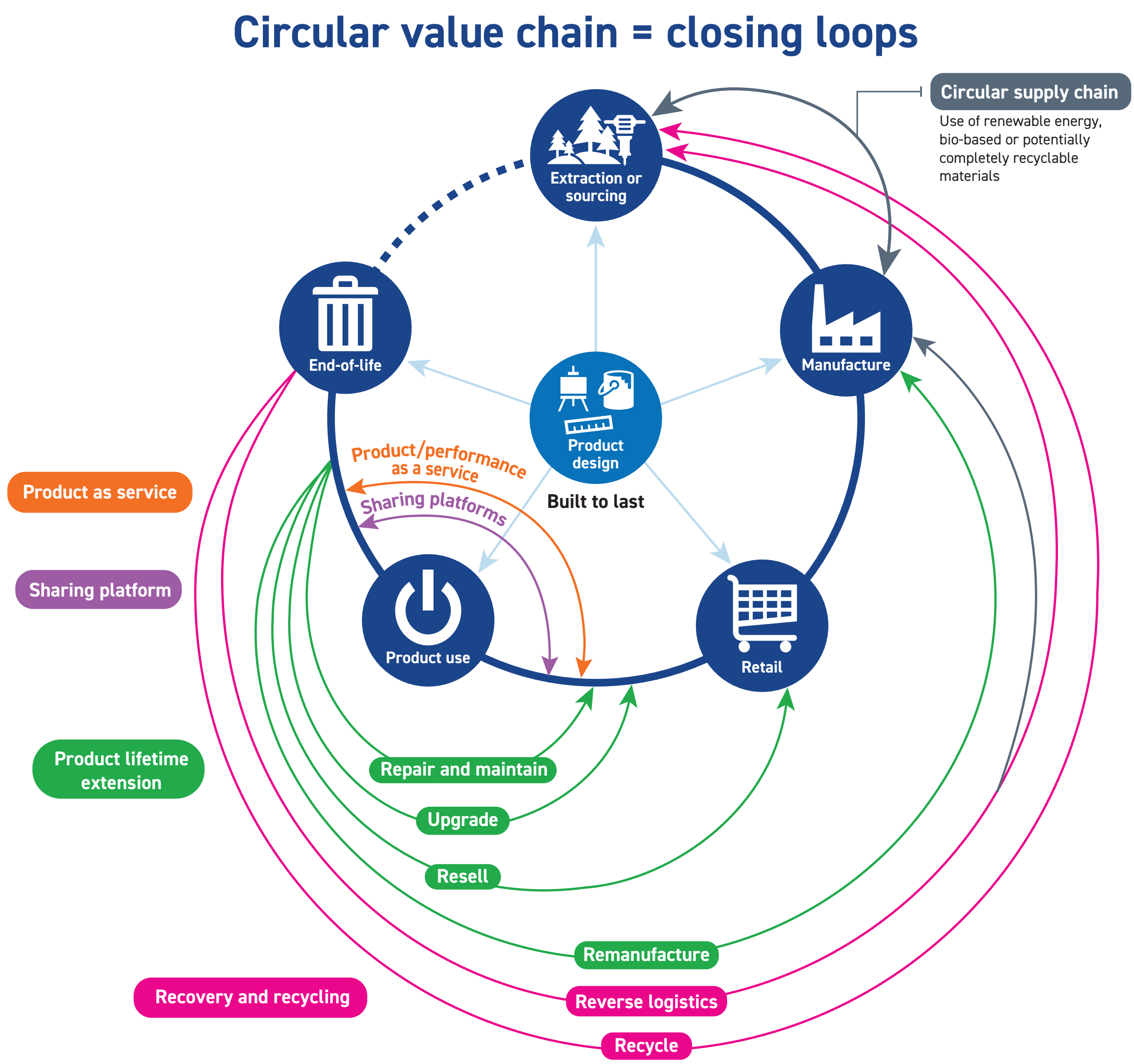


Figure 1: Business model enabling a circular economy

Call to action

1. Build collaborative, sectoral, multi-stakeholder platforms to address entire product life cycle concerns in a scientific manner. This should include product design, for both, goods and services, to standardize composition for ease of closing loops at end-of-life through practices such as reuse, refurbishment, remanufacture and recycling.

   Action: business associations, government, academic research institutes, representatives from specialized departments in companies, waste management organizations, recyclers, upstream manufacturers, businesses, higher education institutions and design programmes.

2. Revisit design of products and services to reduce virgin material consumption and waste generation at all stages of the product life cycle.

   Action: senior decision-makers and R&D departments

3. Reexamine the way in which products are delivered to customers and explore applicability of alternate circular business models such as product as service and shared platforms. This should include engagement with customers to set up models for collecting end-of-life products.

   Action: senior decision-makers, operations/supply chain, marketing and finance

4. Review procurement guidelines and specifications to assess feasibility of secondary inputs (deriving from recycled material, either waste or end-of-life products).

   Action: businesses entrepreneurs, marketing and distribution functions, procurement/purchase departments within companies.

Chapter 1

Circular economy landscape in India

The concept of circular economy (CE) has attracted considerable interest in India's policy, business, academic, and civil society spheres over the last few years. Unlike traditional economic models defined by short product life cycles, CE focuses on longevity, adaptability, and the smart use of materials. Circular approaches embrace the entire product life cycle, from raw material extraction to end-of-life measures and are not restricted to recycling or waste management.

CE represents a paradigm shift in how resources, products, and waste are perceived and managed so as to maximize the value and utility of resources and energy within production systems The International Organization for Standardization (ISO) defines CE as an economic system that uses a systemic approach to maintain a circular flow of resources by recovering, retaining, or adding to their value, while contributing to sustainable development.[2]

Policy and regulatory landscape

Circular economy in policy

The CE policy in India began gaining traction in the mid-2010s, although concepts related to resource efficiency and sustainability had been part of India's policy framework even earlier. The Government of India enacted the National Environment Policy in 2006, which emphasized sustainable development and was intended to mainstream environmental concerns in all development activities.While this policy was not explicitly framed around the CE concept, it addressed aspects such as resource efficiency, waste minimization, and recycling. The Government introduced revised waste management rules in 2016 under the Environment (Protection) Act, 1986, such as the Plastic Waste Management Rules and E-Waste (Management) Rules. Although these regulations did not explicitly mention CE, they introduced the concept of Extended Producer Responsibility (EPR) into policy, establishing the foundation of CE in India.

NITI Aayog's role in shaping India's CE strategy

As the Government of India's think tank, NITI Aayog provides directional and policy inputs to the Government and has undertaken several initiatives to promote sustainable economic growth. Direct initiatives were taken to address the challenges in the utilization of waste as resource and shape a perspective on the recycling industry in India. NITI prepared strategy papers on resource efficiency in the sectors of steel (with the Ministry of Steel), aluminium (with the Ministry of Mines), construction and demolition (with the Ministry of Housing and Urban Affairs), and e-waste (with the Ministry of Electronics and Information Technology).[3]

To accelerate the transition to a CE, NITI Aayog constituted 11 committees for 11 focus areas (Table 1) in 2021.[4] These committees were led by the concerned line ministries of the Government and comprised of officials from the Ministry of Environment, Forest and Climate Change (MoEFCC; NITI Aayog; domain experts; academics; and industry representatives. The focus areas covered 11 end-of-life products/ recyclable materials/wastes that either continue to pose considerable challenges or were emerging as new challenging areas that must be addressed holistically.

Focus areas and corresponding line ministries

Focus Area	Line Ministry
Municipal solid waste and liquid waste	Ministry of Housing and Urban Affairs
Scrap metal (ferrous and non-ferrous)	Ministry of Steel, Ministry of Mines
Electronic waste	Ministry of Electronics and Information Technology
Lithium ion (Li-ion) batteries	NITI Aayog
Solar panels	Ministry of New and Renewable Energy
Gypsum	Department for Promotion of Industry and Internal Trade
Toxic and hazardous industrial waste	Department of Chemicals and Petrochemicals
Used oil waste	Ministry of Petroleum and Natural Gas
Agriculture waste	Ministry of Agriculture and Farmers' Welfare
Tyre and rubber recycling	Ministry of Environment, Forest and Climate Change
End-of-life vehicles (ELVs)	Ministry of Road Transport and Highways

The action plans, which include both regulatory and developmental initiatives, were finalized in 10 sectors by early 2022 and are currently being implemented by the respective ministries along with the relevant stakeholders for each sector.Several cross-cutting aspects emerged from these action plans – developing a robust EPR framework, infrastructure, standards for secondary raw materials, incentives/disincentives, eco-labelling, green procurement, design for the environment, among others.

To give focused attention to CE, the Circular Economy Cell was also constituted in NITI Aayog in September 2022.[5]In mid-2024, NITI Aayog established five specialized working groups on ELVs, tyres, e-waste, scrap metal, and lithium-ion batteries to promote resource efficiency and CE.The aim of the resulting policy recommendations from these working groups is to reduce waste, enhance recycling, and recover materials to create a sustainable ecosystem.[6]

Extended Producer Responsibility as policy driver

Aligned with NITI Aayog's action plans, EPR has been adopted as a major policy option to give thrust to CE in India. The Government has notified regulations on a market-based EPR framework for the following categories of waste:

- plastic packaging waste in February 2022[7]
- battery waste in August 2022[8]
- e-waste in November 2022[9]
- waste tyres in July 2022[10]
- used oil in September 2023[11]
- ELVs in January 2025[12]
- construction and demolition waste in April 2025[13]

Draft EPR rules have also been released for public consultation for the following waste categories:

- scrap metals (non-ferrous) in August 2024[14]
- liquid waste in September 2024[15]
- packaging made from paper, glass, and metal as well as sanitary products in December 2024[16]
- solid waste in December 2024[17]

Other sectoral policies driving circularity

- **Steel Scrap Recycling Policy**

  Steel Scrap Recycling Policy[18], notified in 2019, aims to enhance the availability of domestically generated scrap to promote CE and green transition in the steel sector. The policy provides a framework to facilitate and promote establishment of metal scrapping centres in India for scientific processing and recycling of ferrous scrap generated from different sources, including ELVs.

- **MSE-Scheme for promotion and investment in circular economy**

  Raising and Accelerating MSE Performance (RAMP), launched in June 2022, is being implemented by the Ministry of Micro, Small and Medium Enterprises (MoMSME) over the five-year period 2022-23 to 2026-27. One of the sub-schemes under the RAMP programme is the MSE-Scheme for promotion and investment in circular economy (MSE-SPICE)[19] dedicated to empowering MSMEs in embracing sustainable practices through circular solutions. The primary goal of this scheme is to promote resource efficiency, reduce environmental impact, and enhance the competitiveness of MSMEs in India.

- **Ecomark Rules**

  The Government of India notified voluntary Ecomark Rules[20] in September 2024 to encourage demand for environmentally friendly products while promoting energy efficiency and CE principles. These Rules outline criteria for granting Ecomark for 17 product categories, including household and consumer products (such as cosmetics, batteries, soap and detergents, food items, plastic products, textiles, and electric/electronic goods), focusing on their environmental impact and quality standards.

Business landscape

Circular practices are already deeply embedded in India's economic and business fabric – in fact, they exist in many countries of the Global South and often operate at scale but are not recognized as such or measured/mapped. Many of these circular activities are largely driven by the informal sector, which has long played, and continues to play, a critical role in repair, refurbishment, recycling, and material recovery across different sectors, such as electronics and automobiles. A robust repair and trading ecosystem exists, with marketplaces dedicated to certain products in most large cities: these marketplaces have existed for centuries, but their worth and value is not measured or documented. Over the last few decades, tightly-knit networks and the ability and skill to identify business opportunities have led to some cities turning into hubs for trade and recycling of automotive parts, white goods, entertainment electronics and textiles. A number of businesses are also implementing CE principles into business strategy in an organized and conscious way, with a view to securing resource availability into the future.

Research landscape

Over the last five years, publications on CE and circular practices in India have seen a surge, increasing twentyfold from 2019 to 2024. Studies cover the adoption of CE practices in sectors such as bioenergy[21], textile[22], construction[23], and urban water and wastewater[24]. Given the critical role of MSMEs in India's economy, some studies have also focused on the role of CE in this sector.[25, 26]

The primary emphasis of research has been on the management of diverse waste streams, including industrial waste (such as mining waste and blast furnace dust), municipal solid waste, plastics, construction and demolition waste, healthcare waste, e-waste, and food waste. Major themes of research include:

- recycling
- waste-to-energy
- utilization of wastes
- resource recovery

Many publications have focused on the bio-energy topics, such as valorization of agro-industrial wastes for the biorefinery process[27,28] and the use of biomass as fertilizers.[29,30]

Some studies have addressed the integration of CE principles within supply chains by identifying barriers and enablers for CE adoption,[31] designing sustainable reverse and closed-loop systems,[32] and enhancing performance through tools such as big data analytics[33] , and blockchain[34]. These studies focused on automotive, agri-food, and packaging sectors, with a particular emphasis on MSMEs.

While larger businesses have started mainstreaming CE principles into their operations and business strategies, MSMEs may find it difficult to make the large upfront investments in new technologies, infrastructure, and capacity building needed to transition to a CE. A study involving four MSMEs in the Indian manufacturing sector involved in CE practices found that these practices were generally informal and disorganized, lacking a long-term strategy and vision.[35]

Focus on circular economy at the Confederation of Indian Industry

Since 2018, the Confederation of Indian Industry (CII) has been championing the transition to a circular economy. CII's approach focuses on cross-cutting and core aspects such as product design, innovation, closing loops, metrics, and circular business models. These upstream interventions allow realization of the entire scope of opportunities made available through the practice of circular economy principles.

CII works with Indian industry to promote the principles of a true circular economy by addressing information asymmetry through thought leadership, knowledge creation, stakeholder engagement, and capacity building. Specific activities include

- Developing a CEO guide on circular economy and competitiveness
- Developing sectoral reports in the pulp & paper, iron & steel and cement sector
- Partnering with Circle Economy, a Netherlands-based organization, to initiate work on developing India's first **Circularity Gap Report**.
- Developing business-level metrics to measure and track progress, including special considerations of MSMEs.
- Developing the ecosystem for a circular economy for plastics packaging in India through an initiative called the **India Plastics Pact** and in the automobile value chain through the Sustainable Value Chain Initiative, **EcoEdge**.
- Capacity building of industry, especially MSMEs.
- Initiated an annual conference to create a dedicated platform for Indian business to engage on and discuss cross-cutting and core aspects of circular economy

Chapter 2

Case studies of the practice of circularity principles in India

Introduction

One third of India's GDP comes from approximately 63 million MSMEs. Large enterprises make up a smaller number of units, but these play a significant role in bringing best practices, technology and innovations into operation on the ground. They also make a large contribution to creating awareness and capacity-building within their supply chains and therefore important channels for propagating change and modernization.

The examples and case studies in this chapter collectively demonstrate CE practices in India across multiple sectors and business models, at different scales. Activities of the MSME and informal units are not identified in terms of any structured or accepted terminology, and they are not measured or mapped on to any formal circular principles. However, both kinds of enterprises, large and small, have a role, particularly in the context of circular economy practice and in this chapter, the circular model/principle being followed, is indicated for easy referencing.

The case studies below were invited from three large enterprises (in alphabetical order) Siemens, Tata Steel, and Volvo Construction Equipment, to clearly show how they have imbibed circular economy principles. These studies detail out how they adopted and executed CE concepts and, importantly, what motivated them to follow that long-term path and invest in promoting and scaling up the execution. It is noteworthy that environmental benefits automatically emerge from the adoption of circular concepts – even if they are not the primary target. These companies took the lead, and their work provides many lessons for other businesses to gain from, keeping in mind the importance of scale in the Indian context.

Siemens

Siemens AG, founded in Germany in 1847, began its remarkable journey in India in the 1860s with the pioneering Indo-European Telegraph Line — an ambitious project that connected London and Calcutta (now Kolkata). Each of the examples here, represents a conscious effort to redesign products and services to enhance circularity and resource efficiency, while strengthening business value, economic value, and cost efficiency for customers and for Siemens as an organization. These efforts also contribute to broader societal benefits, as circularity translates into the sustainable use of resources and marks a vital step toward long-term resource conservation.

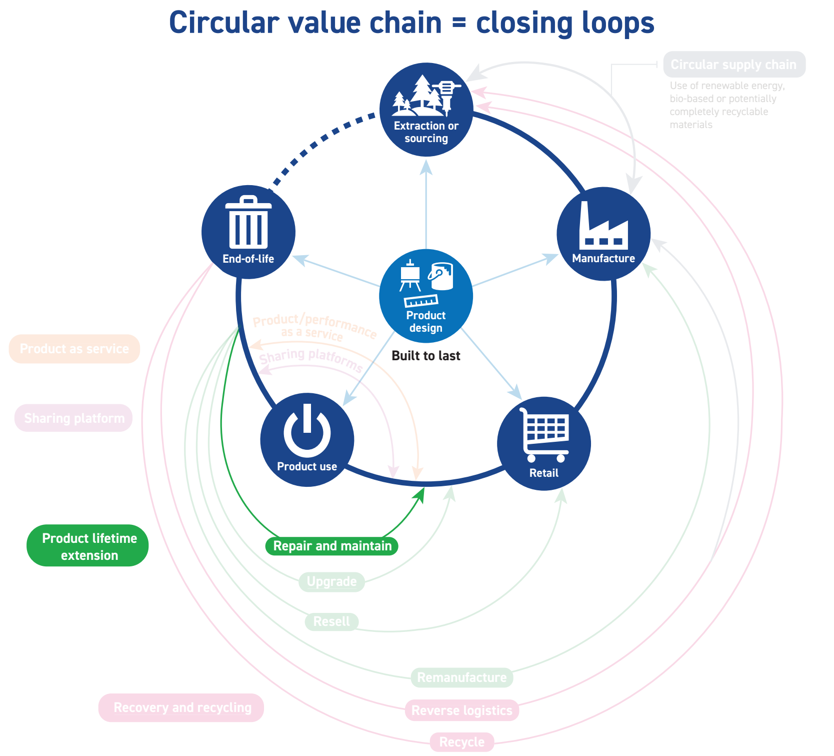


Figure 2: Siemens' interventions are highlighted in green in this representation of a circular value chain. The strategy for circularity in practice is Product Life Extension, which has been achieved by repair and maintenance. Products do not go directly to end of life, but are available for use by the customer after repair.

Practice 1: NXAIR and power distribution

Circular concepts practiced: product design, product life extension.

Benefits derived: use of secondary materials, engagement of SMEs.

Sustainability aspects addressed: Greenhouse gas (GHG) emissions reduction, resource conservation.

Design: Before 2012, Siemens factories worldwide—including in India—designed switchgear independently making it challenging to address Siemens' commitment to sustainability within its products and processes. Therefore, product design, a basic tenet of circularity, was taken up, recognizing that 80% of the circularity of any product was locked into its design. It was therefore necessary to design centrally, to achieve standardization, material-use efficiency and lifecycle performance.

Sustainable product design and product life extension were built into the NXAIR (medium voltage air insulated switchgear), illustrating the translation of a vision, with measurable environmental and business outcomes. India produced the first NXAIR panels, based on robust eco design (RED) principles, and incorporating **modularity, repairability, disassembly, use of secondary materials**, and energy efficiency. Environmentally harmful substances such as SF_6 (sulfur hexafluoride), asbestos, and mercury were eliminated, and, in a further step, other harmful chemical groups such as heavy metals, toxic plating compounds and environmentally persistent organic substances were also excluded. Virgin plastics were replaced with **recycled alternatives, and metals designed for recovery, reuse, or recycling at end-of-life**.

NXAIR became the first Siemens product family to be awarded the EcoTech Label, a verified sustainability mark externally validated by TÜV Rheinland and aligning with ISO 14020 and 14021. The EcoTech Label validates a product's environmental performance through robust eco design criteria across three lifecycle dimensions: value recovery and circularity; use of secondary materials; and optimal use. Certification gives customers confidence in the product's environmental credentials and supports Siemens' broader sustainability goals.

NXAIR Family: *Siemens' switchgear that uses clean air as the insulation medium. The product carries an Ecotech label, certifying its circular design and contribution to sustainable power distribution.*

Increased product life across the NXAIR family is measurable: a 30-year lifespan compared to an average of 20–25 years before the global redesign; reduced CO_2 emissions and resource use; **modular and upgradeable components; recyclable materials, and a circular ecosystem where end-of-life panels are reclaimed by local partners and SMEs**.

The reclamation and refurbishment ecosystem operates through Siemens' extensive local vendor network, engaging SMEs in component production, sub-assembly fabrication and in surface-finishing and logistics. This partnership enables resource-efficient production and enhances SME capability by targeted training and exposure to circular manufacturing and EHS practices.

Sustainability performance of NXAIR product family is systematically tracked through the NX Sustainability Impact Analysis, covering indicators such as carbon emissions, and water use and guiding operational decisions. What began as a strategic initiative based on product design, for an engineering and business solution to enhance product uniformity, efficiency, and lifecycle performance, evolved into a mature circular model integrating circular design principles across every life cycle stage. Deployed across India's renewable energy projects, metros, railways, semiconductor facilities, and government buildings, NXAIR proves that circularity can deliver both environmental impact and business value.

Practice 2: Dual value creation: SF_6 recovery and metal chamber upcycling

Circular concepts practiced: repair/product life extension, product stewardship.

Benefits derived: value recovery of gas, cost reduction, engagement of SMEs.

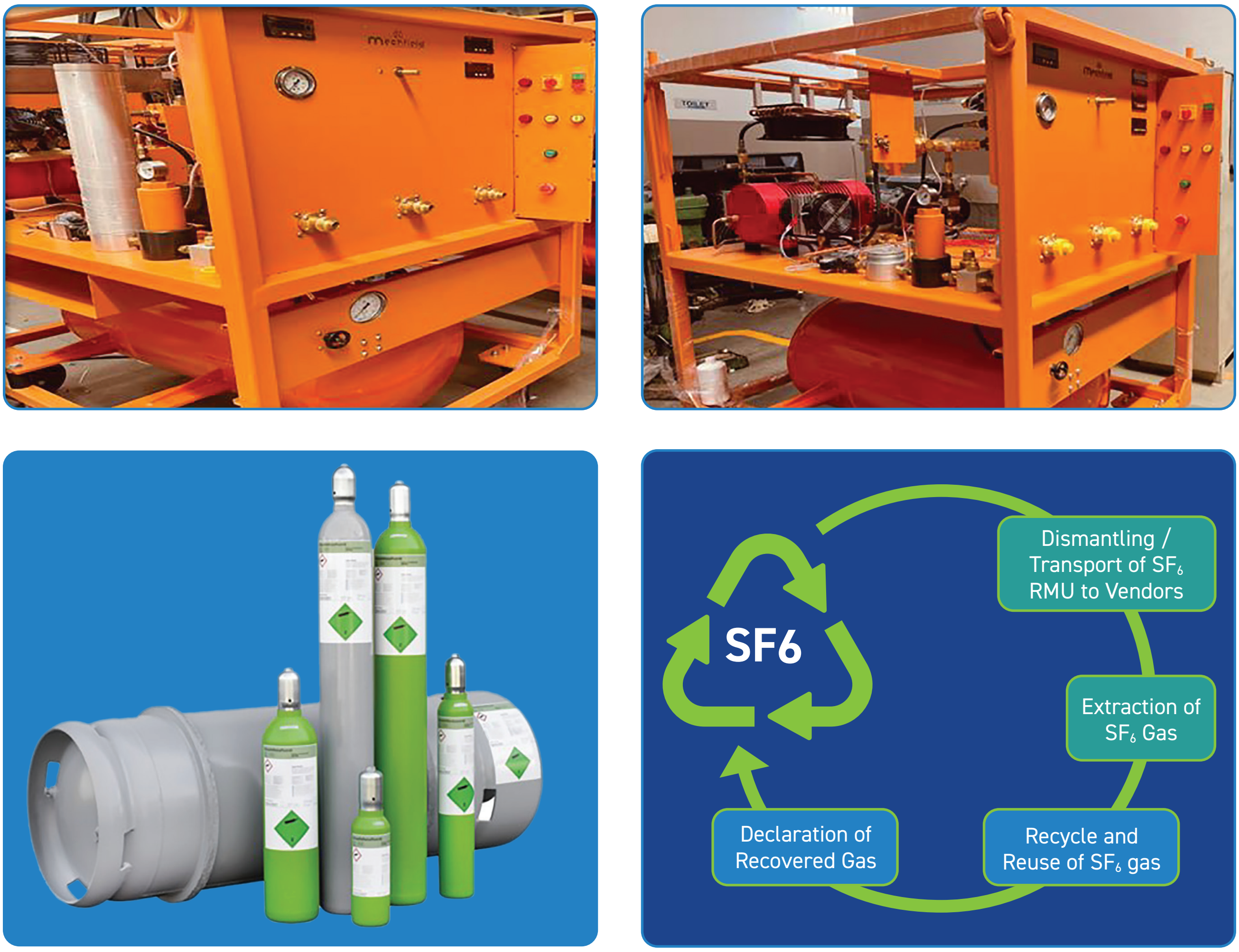
Sustainability aspects addressed: GHG emissions prevented

Ring main units (RMUs) are compact switchgear systems used in secondary power distribution across urban industrial networks. They use SF_6 gas for insulation and arc quenching, safely extinguishing electrical arcs and protecting equipment from high potential faults. In a business-as-usual service scenario, RMU failures are serviced and restored; however, in a government facility in eastern India, Siemens engineers attending a fault, dug deeper and several sources of SF_6 leakage. These were, aging RMU components, improper handling, corrosion, and during storage for scrapping, all of which posed environmental and operational risks. Siemens provided an alternative—safely recovering SF_6 while upcycling metal chambers—and turned environmental liabilities into valuable resources, by practicing circular principles.

MV gas insulated switchgear: Ring main units supplying secondary power across urban and industrial networks.

During operation, a faulty RMU under the contractor's warranty suffered a failure. Siemens' service team evaluated the situation and recommended factory repair because welded stainless-steel SF_6 vessels are sealed for life, making on-site repair impossible. Transporting the bulky equipment to the factory was costly and risky because of the heavy weight, pressurized design, and uncertain feasibility of repair: both, logistically and economically challenging. Scrapping was not a viable choice owing to the extremely high global warming potential of SF_6. On the customer's insistence to provide a cost-effective and viable solution, Siemens proposed an innovative buyback scheme: faulty RMUs would be returned against the value of new replacements, while recovering and purifying SF_6 safely and returning a partial salvage value to the customer. Metal chambers were dismantled and up to 95% of segregated metals were responsibly recycled through local partners, engaging SMEs in recovery, handling, and material processing thus embedding circularity into local value chains. This also included support and development of vendor capability to strengthen local expertise and operational safety.

India provided the perfect landscape for practical application of this repair-recovery model because of the availability of a vendor network and proximity of the manufacturing location. The concept was known in Germany, but high costs associated with such a solution had not permitted practical application. Circularity was manifested into cost savings for customers, lower disposal expenses, and retrofitting opportunities across the country's vast installed base of RMUs and GIS units.



Safe SF_6 recovery from RMUs and metal chamber upcycling — turning waste into circular value.

Encouraged by its success in eastern India, Siemens replicated the approach at a major western port terminal and later extended it to other regional transmission operators. Safe SF_6 recovery and handling, purification for reuse in new or retrofitted equipment, and metal recycling delivered environmental benefits while strengthening customer trust and retention. The model delivered measurable environmental benefits and enabled SMEs to participate directly in responsible recycling.

What began as a customer-specific fix evolved into a scalable model for circularity in medium-voltage equipment, proving that environmental stewardship and cost efficiency can align to deliver tangible sustainability impacts.

Practice 3: Extending life of critical assets: refurbishment and upcycling of air circuit-breakers and MV panels

Circular concepts practiced: repair and refurbishment, product stewardship

Benefits derived: minimized resource use, extension of product life

Sustainability aspects addressed: enhanced safety, involvement of SMEs, creation of green jobs

In western India, a major electricity distribution company faced obsolescence in over 160 units of 3WT8 air circuit breakers (ACBs) after 15 years in service. Replacement would require significant capital, material use, and waste disposal. Consistent communication from top management and exposure to sustainability training programs led Siemens engineers to suggest a circular solution via refurbishment and retrofitting.

Initial assessments revealed technical and logistical challenges: unavailable spare parts for older breakers, uncertainty of safe transport for bulky equipment, and uncertainty over whether new spares could be integrated into the legacy design. The warranty was another hurdle—since the product originated from Siemens global, coverage could only be extended to the specific replacement parts, with no standard warranty for the refurbished breaker. In addition, every modification to the globally supplied 3WT product required strict quality approvals from Siemens AG headquarters in Germany.

Through collaborative problem-solving and dedicated cooperation across Siemens quality teams in India, Germany and elsewhere, each of these challenges was systematically addressed. This spirit of teamwork ensured a technically sound and compliant refurbishment and demonstrated how collaboration within the company could overcome complex barriers while extending the life of critical infrastructure and minimizing resource use.

A two-pronged approach was implemented: repair and restoration of existing ACBs, and integration of modern 37WT protection units for enhanced safety and monitoring.

A pressing need at one utility paved the way for a refurbishment journey that crystallized into a standardized 3R model—repair, refurbish, retrofit/recycle—fit for diverse breaker types. Circularity was embedded throughout the process by **refurbishing components, minimizing waste, extending operational life through retrofits, and reducing material demand**.

The success of this approach opened new refurbishment opportunities across sectors, including a brewery in southern India, a global facilities management provider, and Siemens' own operations in western India. The initiative, which began with legacy ACBs for a utility customer, soon expanded to other low-voltage products such as contactors, fuses, and panel spares—demonstrating the scalability and repeatability of the circular refurbishment model.

Siemens engaged SMEs for component recovery, part replacement, and safe handling within its quality-controlled refurbishment ecosystem—embedding circularity into local value chains while strengthening technical capabilities through exposure to Siemens' standards, training, and on-site demonstrations in **safe dismantling, refurbishment, and logistics**. The engineering fix for one customer structured into circular service model within Siemens India's service strategy.

In eastern India, a major industrial power facility was struggling with frequent flashovers in ageing medium voltage panels over two decades old. 8BK80-3AF panels, obsolete breakers and outdated relays posed operational risks, but detailed diagnostics showed that a complete replacement was unnecessary. Based on the findings, Siemens launched a targeted refurbishment program to restore performance, extend asset life, and minimize material use. By engaging local SMEs to carry out upgrades and digital retrofits, Siemens reduced downtime and costs and enabled feature upgrades within existing infrastructure also fostering local circular capabilities. Through selective component upgrades, insulation improvements, and assembly retrofits, Siemens refurbished 148 panels—extending their life by 10-15 years while restoring reliability and aligning with circularity goals.

As the work progressed, the scope expanded to brownfield digitalization — introducing sensors for real-time monitoring, relay networking for asset management, and integration with a digital solution for electrical planning that enables efficient and compliant network design. These initiatives were consciously aligned with Siemens' circularity principles and circularity benefits realized at every step: refurbishment minimized material use, retrofits enhanced safety and performance, and life extension avoided premature disposal. To ensure long-term success, Siemens trains customer teams to build internal capability, while end-users jointly supervised on-site refurbishment activities, fostering collaboration, hands-on learning, and true customer delight.

Retrofit and restore: *extending the life of obsolete air circuit breakers with modern 37WT protection units, driving circularity and enhanced safety.*

Conclusion

These case studies demonstrate how circular design and proactive innovation convert operational challenges into measurable environmental and business gains. Circularity is no longer an abstract ideal—it is a practical pathway for sustainable growth in India. By designing for longevity, enabling resource recovery, and embracing innovative business models, Siemens shows how industries can reduce environmental impact while creating economic and social value. Opening channels for MSMEs is critical, enabling them to participate in material recovery, refurbishment, recycling, and secondary manufacturing, while generating thousands of green jobs across the ecosystem. Achieving a circular economy requires collaboration across businesses, supply chains, and policymakers. India's sustainable future depends on collective action, strengthening local manufacturing resilience, reducing import dependency, and boosting global competitiveness. Together, we can unlock new growth opportunities, strengthen resilience, and ensure industrial progress goes hand in hand with environmental stewardship.

Tata Steel

Motivation

The idea of entering the steel recycling business began gaining traction in the late 2010s, driven by a convergence of macroeconomic and environmental factors.

- India's steel demand was projected to double over the next decade, creating immense pressure on raw material availability and cost structures.
- Rising concerns about carbon emissions from traditional blast furnace steelmaking highlighted the urgent need for greener alternatives.
- The **National Steel Policy 2017** reinforced this imperative by emphasizing capacity expansion alongside environmental sustainability. However, the existing ferrous scrap ecosystem in India was highly fragmented and informal, lacking quality control, traceability, transparency and had high dependence on imported scrap for large-scale EAF operations. This presented both a challenge and an opportunity: without intervention, the industry risked inefficiency, resource depletion, and non-compliance with global sustainability norms.

Circular value chain = closing loops

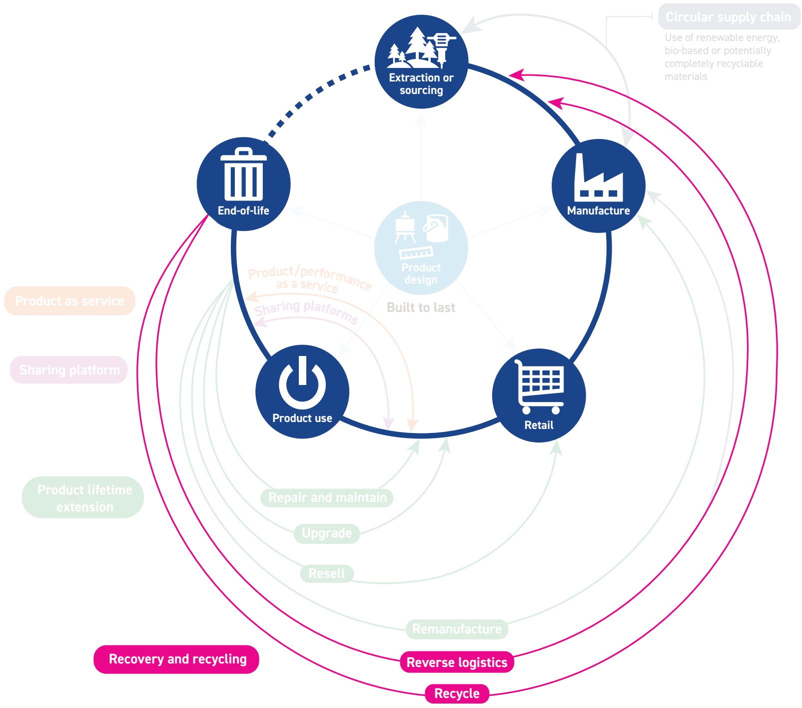


Figure 3: Tata Steel's interventions are highlighted in pink in this representation of a circular value chain. The strategy for circularity in practice here, is Recovery and recycling, which has been achieved by recycling supported by robust reverse logistics. Products do not go directly to end of life, but return again to the value chain for recycling, thereby avoiding the need to extract virgin resources.

Had Tata Steel continued with a business-as-usual approach, the next decade would likely have focused on incremental improvements—enhancing operational efficiencies, optimizing resource utilization, and incorporating reverse logistics. While these measures could have delivered short-term gains, they would not have addressed the fundamental challenge of decarbonization mandates and resource scarcity looming over the steel industry. Traditional blast furnace operations, even with efficiency upgrades, would still rely heavily on virgin raw materials and emit significant carbon. The problem was identified by Tata Steel's leadership, led by Mr. T. V. Narendran, who foresaw that continuing with a linear model—dependent on virgin raw materials—would not only escalate costs but also hinder Tata Steel's ability to meet global sustainability benchmarks. With increasing emphasis on decarbonization and circular economy practices, the absence of an organized scrap processing system emerged as a critical gap that needed urgent attention.

Practice

Engineering a new steel production paradigm

Circular concept practiced: reduce ore extraction, reduce waste of valuable material

Benefits derived: value recovery of metal, engagement of SMEs in organizing reverse logistics, reduction in dependence on virgin metal, reduce environmental degradation.

Sustainability aspects addressed: GHG emissions reduction, work-creation for entrepreneurs in creating support systems for circularity, minimizes ecological damage during extraction.

In 2017, Tata Steel initiated a strategic review of domestic and global scrap markets to assess the viability of Electric Arc Furnace (EAF) technology, which uses steel scrap instead of iron ore and coal. While EAF is globally recognized for its energy efficiency and lower emissions, India's adoption was hindered by a fragmented, informal scrap supply chain. To overcome this, Tata Steel set out to formalize the ecosystem, ensuring **consistent quality and scalability**.

The company signed a long-term agreement in 2019 to establish a state-of-the-art steel recycling plant in Rohtak, Haryana, with a capacity of 0.5 million tonnes, operating on a "build, own, operate" model. Alongside physical infrastructure, Tata Steel launched FerroHaat™, India's first digital scrap sourcing platform, enabling transparent, direct transactions and real-time pricing. To build trust and adoption, Tata Steel conducted training sessions, provided 24/7 support, and introduced branded scrap products—Tata FerroBaled and Tata FerroShred—to assure quality.

To further strengthen operations, Tata Steel integrated AI/ML-based quality assessment and image analytics to classify scrap grades and detect hazards, ensuring safety and efficiency. The company also engaged in policy advocacy, shaping **national scrap recycling standards** and compliance frameworks. This holistic approach—combining physical infrastructure, digital innovation, and technology—laid the foundation for India's first organized steel recycling ecosystem.

The Steel Recycling Business (SRB) initiative reflects Tata Steel's commitment to embedding circular economy principles into its operations. At its core it treats scrap as a valuable resource, reducing dependence on virgin raw materials and minimizing environmental degradation. This approach is complemented by **closed-loop system**, where scrap collected, processed, and reintegrated into the steel value chain—creating a **regenerative cycle that optimizes resource utilization.**

To enable this transformation, Tata Steel introduced digital platforms like FerroHaat™, aiming to formalize the scrap trade, and integrated advanced technologies such as AI and machine learning for scrap quality assessment. These innovations ensure efficiency, traceability, and minimal waste, marking a decisive shift from the traditional linear "take-make-dispose" model to a sustainable, technology-driven ecosystem. Together, these practices position Tata Steel as a pioneer in building a circular steel economy for India.

Tata Steel's steel recycling initiative is a cornerstone of its sustainability strategy, driving measurable environmental and social impact. By shifting toward Electric Arc Furnace (EAF)-based steelmaking, the company has significantly reduced its carbon footprint. This transition not only conserves natural resources but also minimizes the ecological damage associated with mining. The initiative embodies circular economy principles by transforming scrap into a valuable resource, creating a closed-loop system that reduces waste and promotes reuse.

On the social front, Tata Steel's entry into the recycling business brought new momentum to the scrap ecosystem. It drew new entrepreneurs and encouraged existing companies to expand. Tata Steel's engagement with kabadiwalas and small scrap dealers has led to improved working conditions, better income opportunities, and access to formal markets. Training programs and digital literacy efforts have empowered these stakeholders, fostering inclusion and social upliftment. The initiative also promotes safer work environments and contributes to community development.

Challenges

Driving this transformation required overcoming significant hurdles. Internally, Tata Steel had to educate and align stakeholders accustomed to conventional steelmaking processes, while addressing skepticism about the viability and quality of recycled steel. Building new capabilities in digital literacy, reverse logistics, and sustainability practices was essential. Externally, integrating informal scrap dealers into a formalized system posed challenges of trust and compliance. Despite these obstacles, strong leadership and a clear vision enabled Tata Steel to navigate resistance and establish a robust foundation for circular innovation.

Tata Steel's foray into Steel Recycling is more than an operational shift—it's a strategic pivot toward a sustainable, circular future. It exemplifies how visionary leadership, digital innovation, and organizational alignment can drive systemic change in a traditionally linear industry. This approach conserves natural resources, minimizes ecological damage from mining, and aligns with Tata Steel's net-zero roadmap for 2045 under Project Aalingana. As India gears up for a scrap boom and global pressure mounts for green steel, Tata Steel's efforts reflect a strategic pivot toward a greener, more inclusive industrial future—one where sustainability is not an add-on, but a core business driver.

Volvo Construction Equipment

Driving Circular Transformation in India's Construction Equipment Industry – The Volvo CE Journey

Motivation

Volvo Construction Equipment is redefining industrial sustainability by embedding circularity into every phase of its value chain—from product design to end-of-life recovery. It is not just a process implementation but an investment mindset with a long-term vision. Globally, Volvo Group has committed to achieving net-zero greenhouse gas emissions by 2040 and 100 percent fossil-free operations across its manufacturing footprint. In India, this commitment translates into a tangible blueprint: a 90 percent solar-powered plant, dealer-led component remanufacturing, reusable packaging in the supply chain, and Equipment-as-a-Service (EaaS) models. Below are descriptions of how Volvo Construction Equipment India is localizing global innovation to advance India's circular economy agenda and sustainable infrastructure goals.

Circular value chain = closing loops

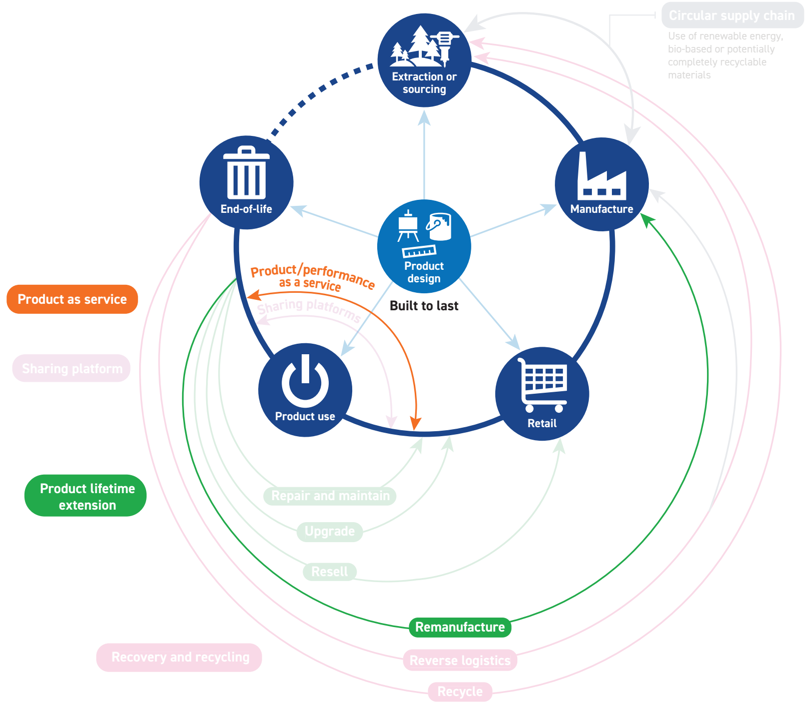


Figure 4: Volvo Construction Equipment's interventions are highlighted in green and orange in this representation of a circular value chain. The strategies for circularity in practice are, Product as Service and Product Life Extension. These have been achieved by remanufacture and renting out heavy construction equipment.

The construction equipment industry is material and energy intensive, making it a critical player in advancing the circular economy. Circular operations decouple growth from resource consumption by designing for longevity, optimizing utilization, and recovering value at the end of life. Volvo Construction Equipment's global circular economy strategy integrates these principles into design, production, and aftermarket—creating a model now effectively localized in India.

Volvo Construction Equipment's circularity framework rests on three pillars: **design for reuse, circular operations, and lifetime value creation**.

Volvo Construction Equipment India's factory operates on approximately 90 percent solar energy, reducing operational carbon intensity by about 75 percent. The facility integrates closed-loop water recycling, advanced waste segregation, and energy-efficient paint processes. These efforts align with Volvo Group's 2040 fossil-free commitment and Volvo Construction Equipment's Zero Landfill ambition. It has demonstrated renewable-powered manufacturing in an emerging market context.

The supply chain mirrors this approach: packaging boxes, pallets, and protective materials are reused multiple times before recycling. Suppliers are adopting returnable packaging systems, reducing packaging waste by up to 25 percent and cutting logistics emissions through consolidation.

Circular concepts practiced: product design for disassembly and recyclability.

Benefits derived: material durability, lowered energy consumption

Sustainability aspects addressed: resource conservation, GHG emissions reduction.

Volvo Construction Equipment's design philosophy emphasizes **disassembly and remanufacture-ready components**. Products are modular, enabling efficient component replacement and reassembly. Approximately 85 to 95 percent of a Volvo Construction Equipment machine by weight is **recyclable**, and many components are engineered for reuse with minimal reprocessing. Digital twin models simulate lifecycle performance, enabling engineers to optimize energy use, durability, and recyclability before production begins.

Extending product life through reuse and remanufacturing

Circular concepts practiced: product life extension through reuse and remanufacture.

Benefits derived: reduction in waste, use of secondary materials, engagement of SMEs.

Sustainability aspects addressed: GHG emissions reduction, resource conservation.

Volvo Construction Equipment's circular strategy extends well beyond manufacturing. In India, dealers are setting up component remanufacturing workshops, inspired by successful models in Indonesia and Poland. These facilities focus on high-value parts such as hydraulic pumps, engines, transmissions, and control valves, achieving up to 85 percent material reuse and 80 percent lower energy consumption compared to new production. Certified rebuild programs **extend machine life** by two to three operational cycles, giving older equipment renewed productivity while **minimizing waste**.

The Certified Used Equipment program provides reliable refurbished machines to small and mid-sized contractors, reducing the demand for new material extraction and offering a sustainable alternative for growing businesses.

Circular concepts practiced: Equipment-as-a-Service (EaaS) product design, product life extension.

Benefits derived: use of secondary materials, engagement of SMEs.

Sustainability aspects addressed: GHG emissions reduction, resource conservation.

Volvo Construction Equipment's Equipment-as-a-Service model redefines customer value by providing performance-based access to equipment. Instead of purchasing a machine, customers pay for uptime, efficiency, and productivity. This approach increases utilization by up to 1.8 times, reduces idle emissions, and enables faster adoption of new technologies, including electric and hybrid equipment. EaaS helps achieve circularity by ensuring machines are used more intensively across multiple projects, **extending their useful life and maximizing output per unit of resource**.

Circular enablers

Digitalization is a cornerstone of Volvo Construction Equipment's circular transformation. Telematics systems track equipment health and usage, enabling predictive maintenance that prevents premature component failure. Over-the-air software updates enhance machine performance and minimize service-related waste. **Digital product passports** are being piloted to document the material composition, repair history, and ownership of each machine—ensuring complete lifecycle transparency. Electrification further amplifies this effort: compact electric excavators and wheel loaders reduce emissions by up to 70 percent and simplify **end-of-life recycling** through **modular battery reuse**.

Supply chain circularity and material loop

Volvo Construction Equipment India promotes circularity across its supply chain by partnering with suppliers for scrap reclamation, oil recovery, and plastic reprocessing. Returnable packaging and optimized logistics reduce waste and carbon emissions. Globally, Volvo Group's supplier framework includes circularity requirements that encourage recyclability, material footprint disclosure, and ethical sourcing practices.

Impact summary

Circular lever	Volvo Construction Equipment India progress	Global benchmark	Indicative impact
Renewable energy use	90% solar-powered plant	80–100% target by 2030	~75% lower CO_2 emissions
Re-manufacturing	Dealer component workshops	Volvo Reman global network	70–85% material reuse; 80% energy saving
Packaging reuse	Multi-cycle supplier program	Standard global practice	20–25% waste reduction
Machine rebuilds	2–3 lifecycle extensions	3–4 global best practice	30–40% resource saving
Electrification	Compact electric models	Expanding globally	Up to 70% lower operating CO_2
Equipment as a service	Pilot fleets operational	Scaling worldwide	1.6–1.8× utilization increase

Challenges and learnings

Core collection and reverse logistics networks need to be scaled to maintain remanufacturing efficiency. Customer education and warranty-backed programs remain critical to build trust in reused components. Policy clarity on taxation and imports for reman parts will further enable adoption. Finally, strengthening dealer capabilities and integrating digital systems are key to sustaining growth in circular operations.

Additional examples of practice of circular economy

Beyond these, a number of Indian businesses are embracing circular business models, as described below, indicating the growing interest in adopting CE principles in the country. These initiatives include reconditioning, refurbishment, recycling, and sharing platform, demonstrating how circularity practices can drive cost savings, resource efficiency, and customer value. These examples have been collated by desk research with support from the annual reports and information on the organization's website.

Company	Need/gap/problem	Solution	Circularity principles and benefits derived	Other sustainability benefits
Tata Motors Commercial Vehicles[36]	Tata Motors needed to address its customer needs by providing high quality, low cost, replacement parts. Mission critical equipment such as engines, if repaired or overhauled in improper plant environment, can pose high operational risks.	Tata Motors introduced the 'Tata Motors Prolife' programme in 2013, a customer-centric service initiative to extend the useful life of engine long blocks, aggregates, and parts through reconditioning. The company provides customers with reconditioned aggregates in exchange for old aggregates, subject to simple acceptance norms. The old aggregates are then sent to reconditioning plants established in Lucknow and Coimbatore and supplied back for use in vehicles.	• **Product life extension:** the programme extends life of aggregates, reduces material use, lowers inventory and logistics costs, and generates additional revenue through exports of some reconditioned parts. • **Reverse logistics and closing loop:** used aggregates are collected, reconditioned, and supplied back for use.	• Reduction in waste generation • Use of less virgin materials and associated energy • Enhanced resource efficiency and value creation through reconditioning practices
Mahindra Lifespaces[37]	Cement is among the most resource-intensive materials used in construction. However, cement, especially ordinary portland cement (OPC), poses challenges in concrete construction due to its environmental impact, high energy consumption, and durability concerns. The company therefore set out to identify an alternative that could meet both performance and environmental goals.	The company explored alternative materials such as ground granulated blast furnace slag (GGBS), a byproduct of the iron and steel industry, and fly ash, a byproduct of thermal plants, for concrete construction. Extensive trials substituting a portion of OPC with these alternative materials showed that GGBS was the most effective replacement, offering reduced thermal cracks, higher long-term strength, improved workability, and decreased environmental impact.	**Circular sourcing:** industrial by-products are used as inputs for new construction materials. Replacing OPC with 40% to 60% GGBS enhanced concrete quality, yielding cost savings of 5% (INR 50–350) per m^3 of concrete.	• Reduction in CO_2 emissions by 20–45% • Use of secondary resources which otherwise would go to landfills
Trringo, a Mahindra & Mahindra venture[38]	Mechanization in agriculture leads to increased productivity and reduced costs, but farmers in India, who may not be able to afford their own tractor and farm equipment, have little or no access to mechanization. The company recognized that the core problem was not a lack of technology, but rather a lack of affordability. With tractor and farm equipment used only during the harvest period and not throughout the year, outright purchases often prove to be uneconomical. The challenge was to make mechanization inclusive and economically viable for all farmers.	Drawing on the vast experience and understanding of rural India that the Mahindra Group had acquired over the decades, it introduced Trringo in 2016, India's first tractor and farm equipment rental and sharing platform. It enabled farmers to access farm machinery on a pay-per-use basis without ownership. The platform operated via a B2B model (company provided tractors to franchises that set up local hubs for renting), and C2C model (large farmers rented their underutilized equipment to others). Farmers could book services via call or mobile app. They would receive a well-maintained tractor along with a professional driver. The program was discontinued in 2023.	• **Product-as-a-service:** programme provides access to tractors and farm equipment on a pay-per-use model, shifting from ownership to a service-based model. • **Shared platform:** optimal use of equipment across multiple users, ensuring tractors and equipment were used to their full potential rather than remaining idle for most of the year.	• Reduction in resource consumption and manufacturing emissions due to shared use of assets • Digital empowerment and inclusion of farmers • Improved access to farm equipment for all farmers • Generation of employment for tractor operators • Creation of business opportunities for the rural businessman

Company	Need/gap/problem	Solution	Circularity principles and benefits derived	Other sustainability benefits
Novelis (a subsidiary of Hindalco Industries Limited)[39]	Aluminium production from bauxite ore is highly resource- and energy-intensive process, making aluminium one of the most expensive metals to produce. This leads to high energy consumption, significant greenhouse gas emissions, and increased environmental degradation. To address this, Novelis aimed to reduce dependence on virgin material by utilizing aluminium's potential to be recycled repeatedly without degradation in quality.	Novelis has invested in aluminium recycling and remelting facilities in India and outside India. It operates closed-loop aluminium recycling systems that source scrap from market, its own processes and via reverse supply contracts with select customers. Over the past decade, average recycledcontent increased from 30% to 63%, with a target of 75% under **Novelis 3x30**. Through these systems, used beverage cans are recycled into new ones within 60 days, and scrap generated in automobile manufacturing is recycled into the same grade of metal and put back into the supply chain.	• **Reverse logistics:** working with customers to collect and channel aluminium scrap for recycling • **Closed-loop recycling:** Scrap is recycled into same grade of metal which is then used to manufacture same products. Closed-loop recycling systems have been developed with some of the world's largest car makers for collecting and recycling aluminium production scrap from the stamping process.It now produces automotive alloys containing up to 80% recycled content.	• Aluminium production from recycled material requires 95% less energy than primary production and generates only 5% of associated carbon emissions. • Recycling preserves metal's intrinsic value, reduces energy use by 90%, minimises environmental impact, and establishes a secure supply chain. • Closed-loop recycling programmes with leading auto OEMs have demonstrated the potential to reduce carbon emissions by up to 100,000 tonnes per year.
Philips India[40]	With increasing healthcare costs, Philips identified the need to provide cost-effective healthcare technology.	Philips' Circular Edition offers high-quality refurbished medical imaging systems at competitive prices, providing healthcare providers with a cost-effective alternative. Through trade-ins or as take back services on customer's request, it takes back all professional medical equipment. Under its Close the Loop program, equipment is refurbished and/or parts are recovered; failing both, equipment is recycled back to raw materials by certified recyclers. Every system undergoes a rigorous seven-step OEM refurbishment process, with any worn or defective parts replaced with original ones. The systems are refurbished to look brand new, fully tested to ensure new-like performance and image quality, custom-configurable equipped with the latest OEM software and backed by the same warranty, service performance levels and training as new systems.	• **Product life extension:** extending product lifespan through refurbishment and reuse of parts, offering about 25% cost savings compared to new systems without compromising performance • **Product stewardship**: ensuring responsible end-of-life management through take-back and recycling programs	Less use of virgin materials and reduced carbon footprint

India's informal economy and circular practices: reverse logistics and secondary marketplaces

Today, economies operate by sending out and distributing products and services to a large number of customers through a few factories – that is, in a **one-to-many** mode. One of the basic challenges in a circular economy is collecting the materials which have been dispersed to millions of households or customers – this is the challenge of **many-to-one**, or, simply, collection.

If products are designed for ease of collection through many of the modes described in the three detailed case studies presented in the beginning of this chapter, then India's robust informal networks can be mobilized and tuned to carrying out the collection. Indeed, such a system is already in place for many products, and the section below provides examples of some products.

Existence of an end-market for any secondary material 'waste' stream provides the biggest motivation for material to move through a value chain. End markets, even if they do not close the loop in the early stages of a circular transition, help to keep valuable material in the economy.

While the marketplaces exist and flourish, they have been largely unsupported by specific policy or structured financing, representing an opportunity for strengthening and formalization. Here, we do not identify them in terms of any structured or accepted terminology, and they are not measured or mapped on to any formal circular principles, but we have tried to illustrate their value and the many benefits they offer.

In the current context of a top-down policy geared to reduce waste there are some strong enablers which can shift from bottom, up. These include a well-developed system for reverse logistics for many materials (paper, scrap metals, rigid plastics), manned by informal workers seeking livelihoods in and around urban agglomerations where waste is generated in large quantities. Also, there is a robust repair and trading ecosystem, with marketplaces dedicated to certain products in most large cities; some cities have become hubs for trade and recycling of automotive parts, white goods, entertainment electronics, textiles. While the marketplaces exist and flourish, they have been largely unsupported by specific policy or structured financing. Recent policy directives (Chapter 1) have brought about change and a transition will require strong focus on standards, traceability, harmonized terminology, metrics suitable for the Indian context, with particular applicability to SMEs, regulated marketplaces for trading secondary products/materials and very importantly, design.

For the important task of many-to-one aggregation, *kabadiwalas* provide an excellent example of livelihoods based on collection and aggregation of end-of-life material offering reverse logistics via house-to-house visits, for paper, glass, metal, which are all extensively recycled. Over the years end-markets for these materials have developed and matured, and well-established channels now lead from generator (at end-of-life) to recycler and end-market production/application. Informal sector workers, aggregators and traders of all kinds follow the money and value trail. The fact that such micro entrepreneurs exist within a network is an indication of the readiness of the circular ecosystem in India to adopt and formalize practices, using digital platforms, for example, to help with traceability, standardization, aggregation.

However, if products are designed for repairability, upgradation, and modularity (to a fair degree already practiced in the automobile industry), such networks can expand to other materials. Coupled with training for repairs of all kinds and systematic material recovery, immense value can be derived, both in terms of livelihood opportunities and resource recovery, both of which are circular concepts. Here, standards for repair, recovery and certifications will be important supporting aspects of quality assurance, a common concern among customers.

India's informal sector operators have the advantage of a relatively low cost of doing business; it is therefore possible for them to do what a large company cannot, by itself. Some examples below illustrate the presence and practice of a variety of circular models already in practice.

Electronics

Repair, resell, and recycling are already prevalent at scale in this sector, largely dominated by the informal sector presence. According to a report by the India Cellular & Electronics Association (ICEA) in 2023[41], over 90% of the collection volume and 70% of the recycling volume are managed by the informal sector. Only 22% of collected waste from electrical and electronic equipment is recycled by the formal sector, which is characterized by small-scale fragmented capacities and a lack of technical know-how for difficult-to-recycle fractions.

Wire stripping to remove copper from PVC covers in New Seelampur

Source: *Toxics Link (2022). Informal E-waste recycling in Delhi, Photo 43, Page 48*

Over the years, certain neighbourhoods across large cities have emerged as hubs for informal dismantling and material recovery. For example, Delhi is reported to have 15 areas, such as Gaffar market and Seelampur, where more than 150,000 workers across more than 3,400 units manage a large collection catchment area. Once the reusable components are removed, inventory is transported to Moradabad, Uttar Pradesh, wherein additional 1.5 to 2 lakh workers are engaged. It is estimated that Moradabad handles roughly 50% of all the waste printed circuit boards (PCBs) generated in India.

The ICEA report states that about 60% of the devices needing repair are serviced by a cost-effective and accessible informal sector, especially for out-of-warranty devices. Consumers conscious of service quality, which constitute about 18% of the total, choose the formal sector repairs – mostly for devices that are still under warranty. The remaining 22% of the consumers who need repair continue using their devices as is.

Despite a 65% growth last year, product as a service remains an emerging model in India, currently gaining momentum in the B2B segment, particularly for laptops.

Automobiles

An extensive informal network of dismantlers and recyclers collect and dismantle old vehicles to recover material across India. Nearly all of the automobile scrap yards in India are managed by the informal and semi-formal sector. A large number of vehicles are scrapped and stripped in informal, unregulated clusters that have also become hubs for scrap metal and all sorts of recovered and refurbished automobile parts.

This is common in big cities, including Delhi, Kolkata, Pune, Jamshedpur, Indore, Chennai.[42] Mayapuri in Delhi is one such prominent informal recycling hub.[43] The scrap market in Mayapuri is home to discarded vehicles and scrap metal, which arrive not only from all parts of India but also from overseas. Several similar informal hubs have emerged across the country, including Pudupet in Chennai, Ukkadam in Coimbatore, Mallick Bazaar in Kolkata, and Lohar Chawl in Mumbai.

Despite its informal nature, the sector is highly specialized. For instance, some traders deal only in engines, steel rims, or tyres. Parts sold as scrap have their dedicated markets. In addition, there are several roadside mechanics in India who deal with vehicle repair when the vehicles generally go beyond warranty conditions provided by the automobile company.

Formal organized units are developing very slowly in India. Very few formal scrapping centres have been setup so far. The Ministry of Heavy Industries and Public Enterprises (MoHIPE) has set up the Global Automotive Research Centre (GARC) near Chennai, Tamil Nadu, as a demonstration centre. CERO-Mahindra MSTC Recycling Private Limited (MMRPL) operates an automobile dismantling and recycling unit in Greater Noida, Uttar Pradesh. This is a joint venture between Mahindra Accelo and Metal Scrap Trade Corporation Limited (MSTC), a Government of India enterprise. Other automobile companies such as Tata and Toyota are also planning their scrapping and recycling centres.

Solid waste

The informal sector, comprising garbage collectors, waste pickers, waste dealers, small stores, and itinerant merchants, play a vital role in recovering consumer waste.[44] Reportedly, 30–65% of all paper and cardboard, 50–70% of all plastic, and nearly 100% of all glass bottles manufactured in India are recycled, primarily with the interventions of the informal sector. Seemapuri in northeast Delhi is one of many hubs where waste pickers bring, sort, bale, and ship waste resources. Dharavi in Mumbai, Maharashtra, one of Asia's largest recycling centres, alone recycles more than 80% of the plastic waste generated in the city, providing employment to nearly 10,000 people.[45] Since the 1990s, several informal plastic waste recycling firms have come up in the Malda district of West Bengal.[46]

A kabadiwalla consolidates used cardboard cartons in Dharavi on 15 February 2024. These will be sold to workshops which process them into new packaging.

Source: *The Guardian (2025). Fast-fashion recycling: how the castoff capital of the world is making Indian factory workers sick.*

Textiles

Collection and recycling of textiles, especially polyester clothes, take place in the informal sector. Panipat in Haryana is a major textile recycling hub, home to many big and small polyester recycling units within its industrial cluster. Other textile recycling hubs include Ludhiana and Samana in Punjab; Ahmedabad, Surat, Rajkot, and Gandhinagar in Gujarat.[47]

Clothes are sorted before being spun into yarn at a recycling factory in Panipat

Source: *The Guardian (2025). Fast-fashion recycling: how the castoff capital of the world is making Indian factory workers sick.*

Growth of aggregators and new business models

The CE landscape in India is undergoing a major transformation, driven by the rise of aggregators and the emergence of new business models. This shift is particularly visible in two areas: the growth of resale and repair platforms, and the increased adoption of shared mobility and rental services.

Resale and repair platforms

Despite the Indian policy framework not clearly differentiating between repair and refurbishment, the market continues to evolve. Programs such as Amazon Renewed and Flipkart Refreshed have proven the viability and desirability of the refurbishment business model, particularly for premium models. Refurbished devices are 40–60% cheaper as compared to new devices, with refurbishers still making 20% gross margins.[40] Another feature of the Indian landscape is a huge presence of customer-to-customer (C2C) or customer-to-business (C2B) trade in the grey market, mostly without any upgradation. In C2C trade, consumers sell their devices either to local electronics shops or to other consumers via platforms such as **Olx** and **Quikr**. In C2B trade, resellers aggregate the pre-owned devices in Tier 1 and 2 cities and redistribute them to retailers in Tier 3 cities and rural towns.

Shared mobility and rental services

Companies such as Uber and Ola have completely transformed personal mobility, offering on-demand ride-sharing that provides an alternative to traditional taxi services and private car ownership. These platforms use technology to connect users with service providers, offering flexibility and often greater affordability. Similarly, rental services such as **Rentomojo** and **Furlenco** are changing consumption patterns by allowing individuals to rent everything from furniture and appliances to electronics, rather than purchasing them. This model caters to individuals who value access over ownership, offering flexibility for transient lifestyles, reducing upfront costs, and avoiding the hassle of maintenance and eventual disposal.

Chapter 3
Way forward

Having outlined the potential and opportunity for circular economy adoption, it is possible to identify aspects, which could accelerate and strengthen a transition by Indian industry at all scales. Clear policy direction has already been put in place through the EPR guidelines of the Government of India. This can be supported by financial incentives directed towards innovations and new business models, as would a signal via public procurement. Research by India's many institutions of technology and science on material science, traceability methods, metrics, for example would be strong enablers. In industry, the automotive and steel sectors have been practicing circular economy principles for several years and are now adopting a more structured approach with forays into new business models (product as a service) and a focus on reverse logistics for material recovery. It is also possible for industry to work collaboratively to set up standards and harmonized compositions for specific applications, thus greatly increasing the recyclability of materials.

Some suggestions for the way forward towards building a circular economy at a macro level are listed below.

1. Formalization and integration

- Introduce licensing, certification, and standardized grading for suppliers, refurbishers, and scrap dealers.
- Incentivize small and informal players to participate in formal circular value chains through subsidies, tax benefits, or access to digital platforms.
- Promote partnerships between large corporations and informal sector actors to enhance inclusion, trust, and operational reliability.

2. Quality standards, traceability and safety

- Develop national standards for product design, reuse, refurbishment, and scrap quality.
- Mandate digital traceability for material flows across reuse, refurbishment, and recycling systems.
- Establish safety and operational standards for dismantling, refurbishment, and reverse logistics.

3. Incentives for recycling and circular practices

- Implement carbon credits, tax benefits, or other financial incentives for companies adopting circular design, reuse, refurbishment, and recycling.
- Encourage public-private partnerships to expand collection networks, refurbishing hubs, and secondary markets.

4. Capacity building and awareness

- Support training programs for workers in safety, refurbishment, repair, and digital literacy.
- Promote awareness campaigns on the economic and environmental benefits of circular practices.
- Facilitate upskilling programs to integrate informal players into modern circular supply chains.

5. Regulatory simplification and alignment

- Integrate circular economy strategies—design, reuse, refurbishment, and recycling—into national industrial and sustainability policies.
- Accelerate cross-ministry coordination (e.g., steel, environment, MSME, consumer affairs) for coherent policy frameworks such as those through the NITI Aayog circular economy committees.

6. Market and technology enablement

- Encourage digital marketplaces for reusable, refurbishable, and recyclable materials to improve transparency and efficiency.
- Facilitate technical support, funding, and innovation for startups in circular design, refurbishment, and reverse logistics.
- Promote adoption of technology for quality assessment, material classification, and safety monitoring across circular value chains.

The building blocks of a circular economy are available in India; with the right incentives and visionary leadership by Indian industry and other actors in value chains, it is possible to make the transition to a circular economy at small, medium and large, national scales. Such a transition will bring benefits to industry, the economy at large, and society, by providing livelihoods and reducing environmental impacts.

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The Confederation of Indian Industry (CII) works to create and sustain an environment conducive to the development of India, partnering Industry, Government and civil society through advisory and consultative processes.

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In the journey of India's economic resurgence, CII facilitates the multifaceted contributions of the Indian Industry, charting a path towards a prosperous and sustainable future. With this backdrop, CII has identified "Accelerating Competitiveness: Globalisation, Inclusivity, Sustainability, Trust" as its theme for 2025-26, prioritising five key pillars. During the year, CII will align its initiatives to drive strategic action aimed at enhancing India's competitiveness by promoting global engagement, inclusive growth, sustainable practices, and a foundation of trust.

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CESD works towards bringing local and global macro challenges to the centre stage; building policy consensus on critical issues; strengthening stakeholders' awareness and representation on policy & regulatory reforms and enabling actions that positively impact the environment, nature and communities.

With a vision to drive transformation towards sustainable development, CESD continues to play a focal role in Government-Industry dialogues on national regulations; articulating stakeholders' discourse on global policies; putting forth Indian Industry's stand on macro-economic issues and accentuating the need for sustainable and inclusive transformation.

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