TRANSITIONING TO CIRCULAR ECONOMY: A Possible Approach for India

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Transitioning to Circular Economy: A Possible Approach for India

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Project Team: Research and Analysis Group

Mr. Rahul Mazumdar, Assistant General Manager

Mr. Mayank Khurana, Deputy Manager

Ms. Sakshi Garg, Deputy Manager

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Executive Summary

The world today is on the verge of irreversible damage caused by human-induced climate change over the years. The earth's temperature has risen by 1.1 degrees Celsius relative to the levels that prevailed during the period 1850-1900 due to various anthropogenic activities. Much of the environmental impact that has occurred in the past century due to rising greenhouse gas (GHG) emissions can be attributed to material handling and use[1].

The industrial development anchored on an inherently linear model based on "take-make-waste" approach has come at a tremendous cost. In the last six years itself, an additional half a trillion tonnes of virgin materials, including minerals, ores, fossil fuels and biomass have been consumed and have created enormous volumes of materials, which are mostly wasted after use[2]. Further, in only fifty years, the use of materials globally has almost quadrupled, outpacing population growth[3].

This calls for urgent global action that would focus on systemic changes in the society ranging from transition to clean energy and sustainable production processes to more responsible consumption patterns and minimal wastage of resources.

Circular economy is a "model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing, and recycling existing materials and products as long as possible"[4]. It provides "a framework for uncoupling growth from material extraction, i.e., it facilitates sustainable development by meeting the needs of the increasing population without complete dependence on the use of primary resources".

Incorporating circular economy solutions to Nationally Determined Contributions (NDCs) can prove to be an effective way to keep the temperature rise below 2 degrees Celsius globally. Furthermore, circular economy can contribute both directly and indirectly in achieving the various SDGs adopted by the United Nations member states in 2015. It also helps in cost savings as it helps to reduce production costs and costs originating from resource extraction and generation by reducing resource dependency and resource use.

It is estimated that by adopting a circular path to development, India could create annual value of US$ 218 billion in 2030 and US$ 624 billion in 2050 compared with the current development model[5]. Circular economy also offers a plethora of social benefits, particularly in low-income economies such as creation of jobs in the fields of recycling, services like repair and rental, or in new enterprises aiming at achieving innovation in the use of materials. According to ILO, circular economy shifts would lead to a net creation of 18 million green jobs by 2030, globally.

[1] The Circularity Gap Report 2021

[2] The Circularity Gap Report 2022

[3] Organisation for Economic Co-operation and Development (OECD). (2018). Global material resources outlook to 2060: Economic drivers and environmental consequences

[4] European Parliament. (2022)

[5] Ellen MacArthur Foundation. (2016). Circular economy in India: rethinking growth for long-term prosperity

The concepts of "Reduce, Reuse and Recycle" have been an integral part of Indian culture and lifestyle albeit overshadowed by the rapid rate of industrialisation. The launch of global initiative 'Lifestyle for the Environment- LiFE Movement' by India places circular economy at the helm of sustainable development and positions India as a global leader in "building a green industrial revolution".

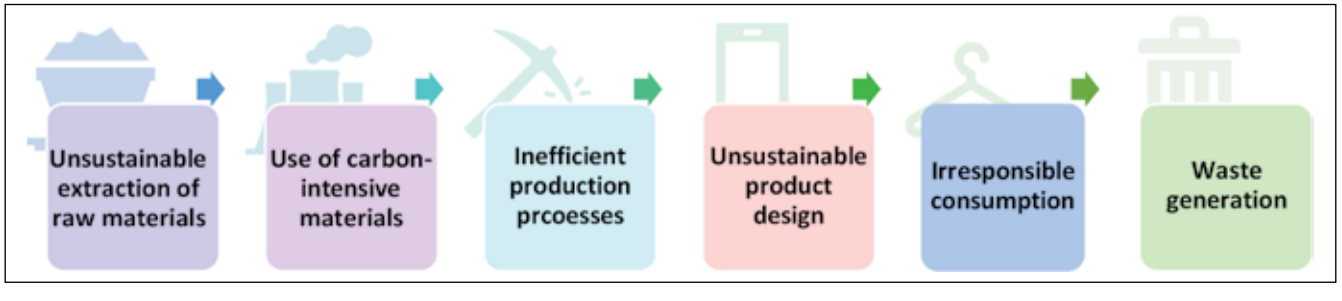
Against this backdrop, India Exim Bank has undertaken this Study to facilitate and bring forth the advancement of a possible circular economy culture in Indian context, while learning from the various policy developments in the global context. The Study focuses on four sectors which demonstrate manufacturing prowess as well as tremendous growth and export opportunities, namely, textiles and apparels; electronics; automobiles; and metals. As transitioning to circular models in these sectors would reap high environmental and economic benefits, the Study documents the prevailing linear practices, present, and potential circular trade areas, and the possible strategies to enable the shift to circular practices.

In all the identified sectors, the extraction processes for raw materials are found to be unsustainable. For instance, in the textiles and apparel sector, India being the largest producer of cotton comes with the concomitant cost of strained groundwater reserves as producing 1 kg of cotton takes up to22,500 litres of water, even higher than the global average of 10,000 litres[6]. Similarly predominant use of virgin minerals and rare-earth elements in the electronics sector, for many of which India is completely import dependent, preponderance of carbon-intensive materials in the automobiles sector and the prevalence of environmentally irresponsible mining practices in the metals sector raise concerns about the continuous supply of resources and the increasing opportunity costs arising from inadequate use of secondary materials.

Many of the existing production models and practices also tend to be inefficient in terms of high carbon emissions, chemicals and water pollution, excessive use of materials and high wastage. For instance, the fashion industry is responsible for 10% of global greenhouse gas emissions. Production of a single cotton and polyester shirt leads to 2.1 kg and 5.5 kg CO_2 equivalent emissions during manufacturing, respectively while a pair of jeans is estimated to produce the equivalent of 33.4 kg of carbon dioxide across its lifespan. Under a business-as-usual scenario, it is forecast that by 2050, textiles and apparel industry will use up to a quarter of world's carbon budget[7]. The increasingly impenetrable product designs and planned obsolescence practices in the electronics space are also detrimental to the environment.

Not just manufacturing, the growing irresponsible consumption practices are also taking a toll on existing resources and strengthening the linear models across industries. It is estimated that an average person in 2014 bought 60% more clothing and kept it for half as long as compared to 2000. The more sobering issue is the underutilisation of this growing waste stream. In the clothing and apparel sector, lack of recycling and underutilisation

Exhibit 1: Linear Model at Play Across sectors



[6] Water Footprint Network research

[7] Materials Systems Laboratory, 2015; UN.(2019). Act Now for Zero-Waste Fashion

of the waste amounts to a loss of more than US$ 500 billion of value each year[8].

Electronics have emerged as the world's fastest-growing waste stream[9]. Within the last five years, annual e-waste generation has increased from 44.7 million tonnes to about 50 million tonnes in 2021[10]. Out of the total waste, only around a fifth is recycled under the desired conditions[11]. This has led to colossal losses due to lack of realization of value from the waste as e-waste contains many high-value and scarce materials such as gold, platinum, cobalt, rare earths, aluminium and tin.

India, the third largest generator of e-waste in the world collected mere 3.5% and 10% of the total generated e-waste in the country for recycling in 2017-18 and 2018-19, respectively[12]. Further, India may accumulate over 22 million end-of-life vehicles (ELVs) by 2025[13]. With the recycling infrastructure still at a rudimentary state, the country is looking at a huge waste disposal problem.

Thus, right from resource extraction to treatment of waste, the prevailing linear practices across the sectors need to be scrutinised and transformed to minimise pollution and waste creation and maximise social and economic gains.

Circular Economy and International Trade

Circular economy cannot be strengthened in silos at the domestic level. International trade and global value chains play a key role in accelerating the transition and fosters economies of scale which is integral for making the circular economy profitable and scalable. In a globalized world, adoption of circular strategies in more advanced nations also affects the domestic industry of countries like India.

For example, developments in the EU such as introduction of mandatory Ecodesign requirements pertaining to textile composition, chemicals content, quality of zippers, seams etc. may negatively impact India's apparel exports to the region if India fails to comply. It is important to note here that given the inordinate reliance on primary resources globally, circular trade flows alone cannot cater to the demand of industries. Thus, in the years to come, circular economy related trade will act as a complement to conventional resource-based trade.

It may also be noted that the current Harmonised Trade System (HS) does not adequately capture the trade flows associated with circular economy as not all types of wastes are classified. Further, it does not distinguish among waste that has already been valorised i.e., converted into secondary raw material in the country of origin and the waste that is to be valorised after exports in the destination country and waste that cannot be valorised at all. Nevertheless, the Study attempts to evaluate the current circular domestic practices and trade trends in the identified sectors.

1. Textiles and Apparels

Used clothing is becoming an important source of apparel in low-and middle-income countries, much of which is recycled from wealthier nations. For example, Africa has one of the largest used clothing markets in the world. About 80% of the Africans buy second-hand clothes which are imported from countries like the US, Europe, India, and Pakistan[14]. Furthermore, not just in less developed nations, the market for secondhand clothing is booming in high-income nations as well as it is seen as a low-cost source of sustainable fashion. However, the changing consumption trends have hitherto had limited implications on international trade. Exports

[8] UNEP. (2019). UN Alliance For Sustainable Fashion addresses damage of 'fast fashion'

[9] UNEP (2019). Time to seize opportunity, tackle challenge of e-waste.

[10] E-waste Monitor Reports

[11] UNEP (2019). Time to seize opportunity, tackle challenge of e-waste.

[12] Down to Earth. (2021). India collected just 3% e-waste generated in 2018, 10% in 2019: CPCB report.

[13] Centre for Science and Environment. 2020. What to do with old vehicles?

[14] Common Objective. (2018). Trade in Second-hand Clothing – Scale and Impact

of worn or second-hand clothing, at US$ 5.2 billion constituted a paltry share of 1% in world exports of apparels in 2021. Further, exports of mutilated rags stood at US$ 618.1 million in 2021.

Coming to waste arising out of manufacturing processes, it is observed that globally, exports of cotton waste were the highest among all categories of wastes, at US$ 453.8 million in 2021. However, the exports have seen a notable decline from US$ 606 million in 2012. Similarly, exports of waste of man-made fibre have dipped from US$ 295.4 million to US$ 234.4 million during 2012-2021. Exports of flax waste on the other hand, have witnessed a growth, rising to US$ 128.4 million in 2021 and exports of silk waste have more than doubled from US$ 59.9 million in 2012 to US$ 120.2 million in 2021. The declining export values of some categories of textile wastes point at the missed opportunities in valorisation of textile waste.

India is one of the largest mechanical recycling hubs globally with over 900 recycling units. Out of the total estimated waste of 7793 tonnes, equivalent to 8.5% of global textile waste, about 59% is recycled and reused albeit most of it involves low-grade recycling. The remaining 41% is downcycled for use in other industries or is incinerated or sent to landfill[15]. Although the value chain for worn clothing and textiles has existed for decades, trade is still at a rudimentary stage with the presence of only a few established players in the market.

India's exports of worn clothing constituted a share of 0.6% in its total apparel exports in 2021. From US$ 65 million in 2012, the exports have grown moderately to US$ 85 million in 2021. As regards imports, back in 2012, India's imports of second-hand clothing, at US$ 107 million constituted a share of 25% in India's total imports of apparels. With US$ 82 million of imports in 2021, the share has gone down to 6.6%. The imports of mutilated rags, in contrast have increased considerably during 2012-21, from US$ 67 million to US$ 224 million making India the largest importer. The exports have also increased from US$ 16 million to US$ 28 million during the period. Furthermore, in 2021, India was largest exporter of cotton waste, the third largest exporter of silk waste, and the sixth largest exporter of flax waste.

It may be noted that imports of second-hand clothing and mutilated rags fall under the restricted category in India's import policy. The imports are only allowed via the Mundra port. From the port, the imports are directly transferred to the importers located at Kandla Special Economic Zone for processing, sorting, reexport, and recycling processes. Notwithstanding the restrictions, India has high import demand particularly for mutilated rags. To capitalise on the growing attention towards sustainable clothing and minimise textile waste, India needs to place itself as the leading recycling hub and exporter of secondary textiles and apparels.

2. Electronics

In global supply chains, e-waste often originates in developed regions such as Europe, the US, and Japan. Instead of dispatching to recycling facilities, the waste in these countries is often transported to developing countries to avoid the strict domestic regulations pertaining to recycling and save costs. The diversion of waste has resulted in underutilisation of recycling facilities in these countries. For example, Australia reportedly recycles only around 5% of e-waste collected but exports around 60% of used computers. Trade is also driven by the demand for second-hand goods in developing countries.

The current global HS codes do not differentiate between new and used electronics. Further, there is lack of differentiation between e-waste, used electronics, and secondary materials extracted from e-waste in the context of international trade flows. Due to the growing importance of waste as a resource and to monitor the international flows of these goods, the HS 2022 edition will include new specific codes for electronic scrap and waste suitable only for disposal or recovery operations under a new heading 85.49.

[15] Fashion for Good. (2021). Wealth in Waste- India's Potential to Bring Textile Wate Back into the Supply Chain.

The Study has attempted to gauge trade in e-waste by analysing the flows of waste and scrap of primary cells, batteries, and accumulators. In 2021, the world exports of waste and scrap of cells, batteries and accumulators stood at US$ 1.6 billion, up from US$ 880 million in 2012.

In India, more than 90% of the e-waste is processed by the informal sector consisting of waste pickers[16]. They collect, dismantle, and recycle the waste outside the regulated system, often adopting non-scientific and dangerous methods. Since the extraction processes may not be very efficient, informal recycling doesn't lead to optimum extraction of precious resources from the e-waste and poses serious health risks for the workers.

India's trade in waste and scrap of cells, batteries and accumulators has seen a remarkable rise during the last decade. Exports have increased at an AAGR of 114%, from US$ 0.3 million to US$ 1 million. During 2012-2021, while the imports have grown at an AAGR of 42%, from US$ 22 million to US$ 259 million. This indicates the increasing demand for e-waste in India. As a matter of fact, imports of e-waste into India, are banned[17] except for refurbishment and re-exportation of second-hand goods. However, due to the difficulties faced in differentiating between the two and the challenges faced in monitoring at the ports, imports of e-waste are prevalent.

E-waste is a valuable resource whose full potential is not being realised currently. With robust processing standards, regulated trade of e-waste and investments in relevant technology, India can establish sustainable value chains in the sector and become a global supplier of secondary materials extracted out of the waste.

[16] CSE (2020). E-Waste Management In India: Challenges And Agenda

[17] Under the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016,

3. Automobiles and metal scrap

Globally, the total number of used vehicles sold is estimated to be at least double that of new vehicles[18]. The main factors driving global trade of used vehicles are the high degree of affordability they offer, the need for frequent replacement of vehicles in developed countries due to stringent emission standards and the lax regulations in developing economies, which makes exporting more cost effective for developed car manufacturing countries. Despite a flourishing market, there are currently no regional or global agreements on trade in used vehicles[19]. Developing countries, in general, either have banned the import of used vehicles which however is poorly enforced or have limited or no regulations on governing the quality and safety of imported used vehicles. Equally, most of the developed countries do not have restrictions on the export of used vehicles

The automobile recycling ecosystem in India, is largely informal and unorganised. While there is an established ecosystem for sourcing, dismantling, and selling of spare parts and scrap, the methods used are unscientific with use of rudimentary hand tools. Ferrous and non-ferrous metals make up 75% of a vehicle. As end-of-life vehicles (ELVs) in India continue to pile up, their adequate recycling would release huge quantum of secondary raw materials, thereby leading to a reduction in extraction and use of virgin materials. India's high import dependence on metal scrap may also decrease. In 2021, India was the largest importer of aluminium scrap, second largest importer of ferrous scrap and the sixth largest importer of copper scrap. With negligible exports, high deficits are recorded in trade of metal scrap.

Developing Global Policy Landscape for Transitioning to a Circular Economy

Policymakers across the globe are faced with the intricate task of accelerating the shift towards

[18] UNEP. (2020). Used vehicles and the environment.

[19] Ibid.

circular economy models and at the same time, minimising the crippling impact it could have on the stakeholders, mostly on the businesses operating in the informal sector, less privileged consumers etc.

The launch of the EU's Circular Economy Action Plan in 2015 was a pioneering step towards taking concrete action for transitioning towards a circular economy. Subsequently, new Circular Economy Action Plan was launched in 2020. It focuses on the entire life cycle of products and adoption of digital technologies for tracking, tracing, and mapping of resources. Notably, the plan also proposes a Global Alliance on Circular Economy and Resource Efficiency (GACERE), an alliance of governments for working together towards a global just circular economy transition and sustainable management of resources.

In the USA, accelerating recycling rates is being seen as a priority for developing circular economy. Under part one of its National Recycling Strategy, the US envisions to achieve the national recycling goal of 50% by 2030 as against the current recycling rate of 32% through emphasis on residential and commercial recycling systems.

In Ireland, the landmark Circular Economy and Miscellaneous Provisions Act has been passed. It defines the circular economy for the first time in Irish domestic law, re-designates the existing Environment Fund as a Circular Economy Fund and mandates the development of Circular Economy Strategy and National Food Loss Prevention Roadmap, among others.

The Anti-Waste law of France is another pivotal legislation to eliminate waste and pollution from the design stage, ban destruction of unsold non-food products such as clothing, shoes, beauty products etc. and introduce a mandatory repairability index on electronic and electric products to increase the proportion of products that get repaired.

In India too, achieving circular economy is increasingly becoming a priority. Committees in 11 sectors have been formed to prepare action plans for transitioning to circular economy. The sectors include "ferrous and non-ferrous metals; lithium-ion batteries; tyre and rubber recycling; gypsum; ELVs; electronic waste; toxic and hazardous industrial waste; municipal solid and liquid waste; agriculture waste; used oil waste; and solar panels".

Several rules pertaining to efficient use of resources and waste minimisation have also been notified such as the Plastic Waste Management Rules, 2016, further amended in 2018 and 2022; E-Waste Management Rules, 2016, amended in 2018 and 2022; Construction and Demolition Waste Management Rules, 2016; and the Steel Scrap Recycling Policy, 2019. Furthermore, in 2020, the Ministry of Environment, Forest and Climate Change released Draft National Resource Efficiency Policy which is based on the principles of "reduction in consumption of primary resources to sustainable levels, creation of higher value with lesser material use and creation of business models beneficial to the cause of environmental protection and restoration".

Exhibit 2: Select Sector-wise Policies related to Circular Economy

Region	Policy Interventions Implemented/ Planned
Electronics	
EU	– Circular Electronics Initiative to promote longer product lifetimes – Regulatory measures for electronics and ICT under the Ecodesign Directive – Focus on Electronics and ICT as a priority sector for implementing "Right to repair" including a right to update obsolete software – Introduction of a common charger – EU-wide take back scheme for old mobile phones, tablets, and chargers
Austria	– A publicly financed repair bonus introduced for reimbursing a part of the repair costs incurred by the consumers. Up to 50% of the repair costs reimbursed, with a cap of 100 euros per repair case or per year, usually
UK	– Introduced right-to-repair rules that legally require manufacturers to make spare parts available to people buying electrical appliances
France	– Mandates companies to display a repairability score out of 10 for smartphones, laptops, televisions, washing machines and lawnmowers
India	– Notified E-Waste (Management) Rules, 2022 to enable adequate recycling and refurbishing of the e-waste through adherence to extended producer responsibility (EPR) obligations – Bureau of Indian Standards published standards for USB Type-C port, plug and cables for common charging solutions. Mandatory USB Type- C charging announced for all mobile phones and tablets to be sold in India after March 2025
Textiles and Apparels	
EU	– Eco-design measures for textiles – Empower business and consumers to choose sustainable textiles and provide access to re-use and repair services – Incentivise product-as-service models and circular materials and production processes – Provide support to achieve high separate collection of textile waste – Boost textile sorting, re-use, and recycling through innovation, effective industrial applications and regulations such as EPR
France	– First country in the EU to pass EPR laws – Destruction of unsold clothing prohibited – Manufacturers or importers of clothing, linen, and footwear products to either set up officially accredited collection and recycling program or register with one
Sweden	– Passed EPR laws on textiles and clothing – Target to reduce textile waste by 70% in weight by 2028, compared to 2022 baseline data.
China	– Aims at recycling 25% of its textile waste and produce 2 MT of recycled fibre by 2025 – Have a waste textile recycling system 'initially established' by 2025 – Promote green design and use of green fibres in textiles – Promote the application of China Social Responsibility Management System for Textile and Apparel Sector in enterprises – Strengthen technological innovations

Region	Policy Interventions Implemented/ Planned
	Automobiles
EU	– ELV Directive adopted in 2000 – Circular economy Action Plan, 2020 • New regulatory framework for batteries. • Rules on recycled content and measures to improve the collection and recycling rates of all batteries • Address non-rechargeable batteries to phase out their use • Revise the rules on ELVs to include mandatory recycled content • Apply product-as-service solutions
China	– Swap the old for remanufacturing policy provides subsidies to enterprises that collect ELVs and component parts – Establishment of dedicated industrial parks for remanufacturing – Introduced pilot program in 2021 to implement EPR scheme for automobiles.
Japan	– Law for recycling of ELVs in place since 2005.
South Korea	– Act passed in 2007 for regulating the use of toxic substances (e.g., cadmium, hexavalent chromium, lead, and mercury) in vehicles and for establishing a resource recycling system
India	– Vehicle Scrappage policy launched in 2021 • Aims to scrap commercial and private vehicles older than 15 and 20 years, respectively if they fail the fitness test • Automated Testing Stations with state-of-the-art facilities set up

Transitioning to a Circular Economy

The Study suggests a set of strategies that India could potentially adopt and incorporate in its policy framework for transitioning towards a circular based economy.

Develop an attractive market for secondary raw materials

Secondary raw materials are recycled materials that can be used for manufacturing products instead of, or in addition to, virgin raw materials. Recycled metals can, to a considerable extent, displace the demand for virgin production and limit the negative environmental impact emanating from extraction and processing activities. However, the current recycling rates of metals are not commensurate with the increasing global demand. As both the demand and supply of secondary raw materials are much below potential currently, the Study proposes focusing on developing both sides parallelly.

- *Establish quality standards with international cooperation:* Globally, while some standards exist for certain product categories, a comprehensive set of standards for a broad range of secondary raw materials is missing. In this regard, India as a member of the Global Alliance on Circular Economy and Resource Efficiency (GACERE) should push for joint negotiations among the member countries, particularly the EU to establish common standards for assuring smooth cross-border flow of quality secondary materials. This would ensure that India's secondary raw materials are at par with the international standards thereby giving it a head start to become a major secondary raw material exporter.
- *Nudge producers to use secondary raw materials:* To mainstream the use of secondary raw materials, financial schemes need to be designed that nudge producers to diversify their sources of raw materials away from the primary sources. One such scheme could be offering

annual corporate tax benefits to producers who exceed the stipulated minimum percentage use of secondary raw materials out of total raw materials. The threshold for use of secondary raw materials may be based on the total sales of the company in that particular area. As the pricing systems of secondary raw materials are not so developed right now, the schemes may ensure that there is net benefit to the company from greater use of secondary raw materials as compared to their peers who are not using these.

- *Improve information and monitoring of secondary raw material markets*: Unlike primary materials, market information pertaining to secondary raw materials such as prices, quantity processed, player in the market, trade volume, quality etc. is not transparent, particularly in less developed markets. A monitoring mechanism needs to be set up to track the market penetration of secondary raw materials. Further, for ensuring that all necessary information is available with the stakeholders, a website may be developed under the Waste to Wealth mission for listing daily prices of secondary raw materials such as black mass (Recycled ELV lithium batteries), grade-wise recycled copper etc., list of manufacturers, recycling processes used, applications of the secondary raw materials etc.

Incentivise Responsible Consumption

There is decent level of awareness and willingness to switch to circular practices among the consumers, however, there hasn't been a considerable behaviour shift due to several roadblocks. Asymmetry in information about second hand products, apprehensions about quality, high repair costs and other costs of adopting other circular practices are some of the main concerns that consumers have. To address these, the following strategies may be adapted.

- *Circular economy labelling on products:* In India**,** the Bureau of Energy Efficiency mandates star labelling of select electronics to gauge the energy performance. This has had a major impact in influencing consumers' buying decisions towards more energy-efficient devices. In a similar manner, national labelling standards for products manufactured through circular practices such as using secondary raw materials instead of virgin products, refurbishing, through zero waste processes etc. may be developed to enable more responsible buying and to serve as a guarantee of quality. For this, the Ministry of Consumer Affairs along with the Bureau of Indian Standards may form a committee to identify the circular manufacturing processes to be covered and for setting the minimum quality and quantity standards under each practice to qualify for the labelling.
- *Voluntary registration and incentives for repair shops:* Repair businesses in India, particularly for electronics are quite widespread. The Right to Repair framework being developed by the Ministry of Consumer Affairs, Government of India would lead to further proliferation of repair shops. However, given the current informal nature of the sector, consumers may be apprehensive about the quality of services provided. To enable standardisation of services, the concerned ministries for the products covered under the Right to Repair framework may start a voluntary registration process for repair shop owners. Facilities like trainings, technology upgradation, concessional financing etc. may be provided to the businesses on the condition that they follow the standard procedures set by the regulating authorities and provide quality services with a resolution system for customer grievances.
- *Provide support to companies selling circular solutions to consumers:* Many companies, sensing the business opportunities in the circular economy segment, have come up with innovative business models to provide circular solutions. For example, in the electronics sector, companies with end-to-end recycling solutions are making a mark. Being a nascent segment, the businesses face challenges and require support from the government to scale up their operations. Firstly, the Government may provide marketing support to help these companies reach a larger

market, both domestically and internationally. Secondly, as many of these companies have effective solutions but not the wherewithal to implement them at a nationwide scale, the Government may offer its existing distribution networks and infrastructure for purposes such as collecting e-waste and used garments, spreading awareness at the grassroots level etc. Thirdly, an interest subvention scheme may be launched for promoting business activities that provide circular economy solutions. To ensure scalability, a minimum threshold for companies' turnover may be set for the scheme.

- *Rewarding consumers for behavioural changes:* Incentives systems may be set up that nudge consumers to make positive behaviour changes. For example, consumers that drop-off their recyclable/ reusable waste at dedicated collection spots may be offered cash benefits. Providing discounts on products made out of secondary raw materials may also help in driving consumption for such products and assuaging the apprehensions that consumers have regarding the quality and utility of second-hand products. Opening up refurbishing centres for electronics, clothes and other items and providing services at pocket-friendly prices may also encourage consumers to extend the life of their products instead of disposing them.

Boost Trade for a Circular Economy

- *Strengthen and ensure enforcement of import standards:* For the development of India's informal recycling ecosystem to be profitable, there needs to be sufficient level of scale. Import of regulated waste for processing in India could thus further profits for the recycling industry. It would be worthwhile to strengthen import standards for second-hand product categories / waste to bolster the domestic recycling industry and make India a major export hub for secondary raw materials and refurbished products. China's Operation Green Fence, wherein strict enforcement of existing import regulations was practiced, thereby putting a check on low quality of recyclable waste imports, serves as a successful example.
- *Build circular value chains through trade agreements*: Comprehensive trade agreements can play a key role in enabling rapid transition of countries towards circular economy practices. As a matter of fact, EU envisages to mainstream circular objectives in all of its free trade agreements as a part of its Circular Action Plan 2020. With the negotiations between India and the EU for an FTA going on in full swing, India has the opportunity to establish best international practices for circular economy practices in cooperation with the EU. The focus areas in the trade agreements could be on working on a common classification list of goods related to the circular economy; promoting supportive services such as design, engineering, research and development, and digital services; identifying avenues for investments for building circular value chains; and enabling harmonization of standards and regulations for free flow of cross border trade.
- *Introduce green public procurement (GPP) criteria in trade agreements:* In March 2022, India for the first time included the Public Procurement Clause in its Comprehensive Economic Partnership Agreement with the UAE. Many other countries such as the EU, UK and Australia are also eyeing at India's lucrative US$ 500 billion procurement market. Given the high international interest, the Government may consider including GPP clauses pertaining to recyclability and/or recycled content in the upcoming FTAs. As the EU has already proposed minimum mandatory GPP criteria and targets for all its future FTAs, to start with, India may introduce GPP clauses in the FTA with the EU. To ensure proper implementation, robust monitoring systems may also be established.

Establish robust recycling ecosystem

- *Improve collection of waste:* Improving the collection of waste is an essential step towards creating a circular economy. Many countries have stringent laws for minimising contamination of waste. In India, the collection system for waste,

including e-waste, is still in its early stages of development and is facing several challenges. The recent policies such as the scrappage policy for ELVs and the E-waste management rules 2022 are expected to considerably improve collection systems. In addition, the government may take several steps to enhance collection rates and quality. These include awareness campaigns through various mediums such as TV, radio, print, and social media to educate and encourage participation of the people in e-waste collection and disposal processes; greater penetration of e-waste and clothes collection centres and scrappage centres in case of automobiles; and partnerships with private sector to set up e-waste management systems.

- *Support formalisation of recycling units:* As of April 2022, there were a total of 472 dismantlers/recyclers authorised by the State Pollution Control Boards (PCBs)/ Pollution Control Committees (PCCs), with a recycling capacity of 14.3 lakh MTPA while the quantum of e-waste exceeds 3 million MTPA. Compared to this, there are a plethora of informal recycling clusters across the country which are devoid of uniform standards, adequate technology, and safe working conditions. To enable formalisation of recycling ecosystem, firstly, recycling parks with common infrastructure with latest technology need to be set up at the identified clusters. Secondly, comprehensive trainings may be provided to the recyclers regarding the best practices to be adopted with focus on building export capabilities parallelly. Thirdly, as advanced recycling techniques require higher quality feedstock; robust supply chain management may be ensured to guarantee a continuous flow of waste and thereby continuity in supply of secondary raw materials to the users.

Better product design

The design stage is extremely critical as it determines nearly 80% of the products' environmental impacts in terms of energy consumption, life span, repair, reuse, recyclability, and waste handling[20]. Therefore, a pre-planned approach towards circular economy is needed.

- *Build capabilities for zero-waste designs:* As designers lay the foundation for a product, its uses, duration of life, extent of waste creation etc., it is extremely important that they get the right kind of training at the initial stages so as to ensure that lesser wastes go ahead in the process ahead. Some of the steps for encouraging learning could include introduction of mandatory courses and modules on zero waste design, sustainability, and circular economy; incorporation of hands-on activities and projects that promote the principles of circular economy; and building of industry partnerships with organisations working in the field to promote practical learning as well as to provide a platform to students for piloting projects. Furthermore, Centres for Circular Economy may be set up for promoting dedicated research in all major design institutes in India such as the NID, IIT, and NIFT. Funds may also be allocated for setting up incubation centres in the institutes.
- *Incentivise use of sustainable materials:* A slew of government initiatives is needed to drive the industry as well as the consumers towards use of biomaterials. Though many companies are coming up with sustainable clothing materials such as those made from agricultural waste, massive scaling up needs to be done which is not possible without government support. Infrastructure support and fiscal incentives such as lower GST rates for companies working in this space and R&D grants to institutions for carrying out feasibility studies may serve as the stepping-stones for developing a bio-material industry.

[20] Ellen Macarthur Foundation. Recycling and the circular economy: what's the difference?

Chapter

1

Introduction

"In nature, there is no such thing as garbage. Everything in nature is reused or recycled. But we live in a throwaway society. We use something once, and then it's garbage, ending up in landfills or in our oceans, lakes, and rivers. And the wasted energy contributes to air pollution and climate change."

- United Nations

United Nations in its statements has succinctly explained the glaring problem faced by the world today. Human activities have caused around 1.09°C of warming in 2011-20 above the levels prevailed during the period 1850-1900[21], the impact of which is palpable. Further, according to the second part of IPCC's sixth assessment report, Climate Change 2022: Impacts, Adaptation and Vulnerability, 2022, global warming of over 1.5 °C relative to the levels prevailed during the period 1850-1900 is highly likely even if we consider a scenario where greenhouse gas (GHG) emissions release are moderate. Human-induced climate change is causing increasingly irreversible damage to nature and people in the form of increased heat related human-mortality, warm-water coral bleaching and mortality, heavy precipitation events, increased droughts, wildfires and cyclones, ocean acidification and losses of species, among others. Besides, climate change has led to diverse adverse impacts on human systems, including on water security and food production, health and well-being, cities, settlements, and infrastructure.

Moreover, unsustainable use of natural resources and pollution has increased ecosystem vulnerability to climate change. In the last six years itself, an additional half a trillion tonnes of virgin materials, namely minerals, ores, fossil fuels and biomass have been consumed and have created enormous volumes of materials, which are mostly wasted after use[22]. Further, in only fifty years, global use of materials has almost quadrupled, outpacing population growth[23].

Rising CO_2 Emissions

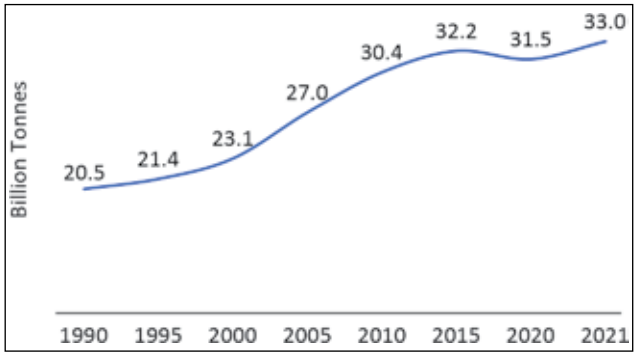
While in 2020, CO_2 emissions reduced by 5.2% and in all probability, this was due to reduction of activities amidst the global pandemic; in 2021, owing to strong rebound in the global economy and excessive use of coal, CO_2 emissions increased by about 1.5 billion tonnes, to 33 billion tonnes (Figure 1).

[21] Intergovernmental Panel on Climate Change (IPCC) Report 2022

[22] The Circularity Gap Report 2022

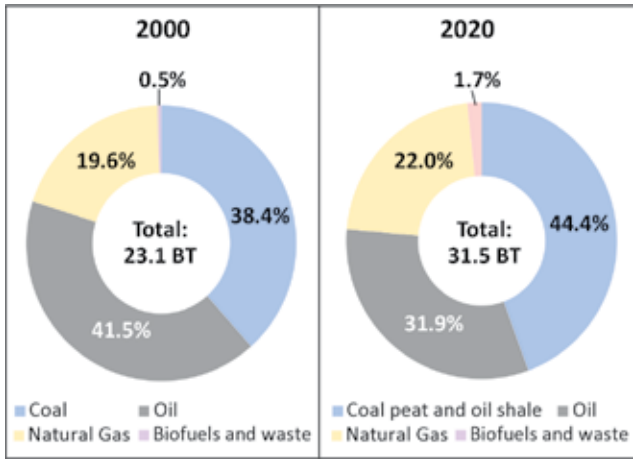
[23] OECD. (2018). Global material resources outlook to 2060: Economic drivers and environmental consequences (pp. 1-24, Rep.).

Figure 1: Global Energy related CO_2 Emissions



Source: International Energy Agency; India Exim Bank Research

Figure 2: Major Energy Sources of Global CO_2 Emissions

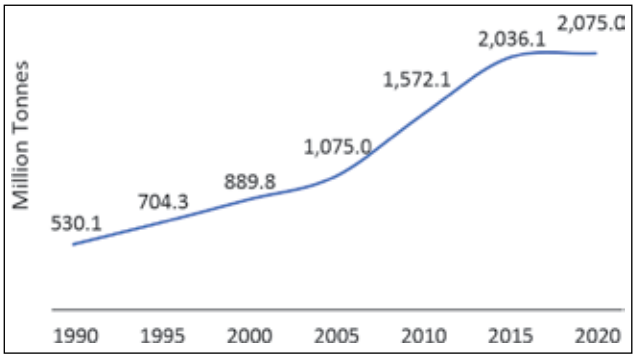


Source: International Energy Agency; India Exim Bank Research

From 2000 to 2020, share of coal in total CO_2 emissions has increased from 38.4% to 44.4% while share of oil has gone down from 41.5% to 31.9% (Figure 2). Reliance on natural gas and biofuels and waste has also increased from 2000 to 2020. According to International Energy Agency, CO_2 emissions are estimated to increase to 33.8 billion tonnes in 2022 – a slower rise compared to 2021 owing to the deployment of renewable energy technologies.

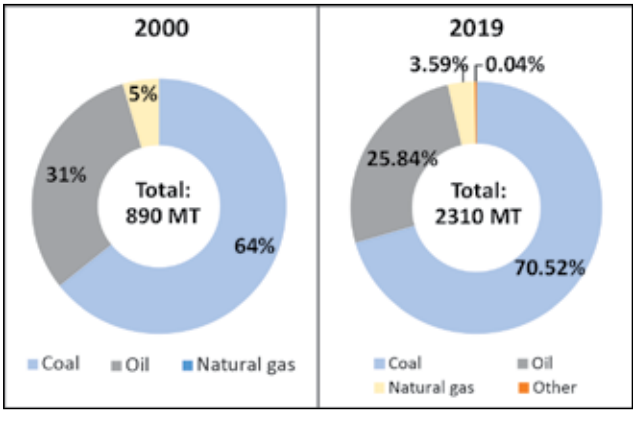
In India's case, the CO_2 emissions increased to 2.1 billion tonnes in 2020, a share of 6.6% in global CO_2 emissions (Figure 3). In line with the global trend, CO_2 emissions from coal have increased over the years. In 2019, coal consumption in India produced 1.6 billion tonnes carbon emissions and accounted for 70% of India's CO_2 emissions. Oil and natural gas produced 597 Mt and 83 Mt of carbon emissions while from other sources, 83 Mt carbon emissions were observed in 2019 (Figure 4).

Figure 3: India's CO_2 Emissions



Source: International Energy Agency; India Exim Bank Research

Figure 4: Major Energy Sources of India's CO_2 Emissions



Source: International Energy Agency; India Exim Bank Research

Climate Commitments

In 2015, countries across the globe took cognisance of the rapidly growing negative impact of climate change and came together to enact the Paris Agreement. Paris Agreement is a legally binding international treaty aimed at limiting global warming to 2° Celsius (preferably to 1.5° Celsius), compared to pre-industrial levels.

The countries reached yet another breakthrough in 2021 at the 26th Conference of Parties (CoP26) where they reaffirmed their commitment to work collectively towards limiting global warming below 1.5° C and set more ambitious targets to reduce GHG (greenhouse gas) emissions by 2030. Besides, the nations also made collective commitments to "limit methane emissions, halt and reverse forest loss, align the sector by net-zero by 2050, accelerate the phase-out of coal, speed up the transition to electric vehicles and end international financing for fossil fuels", among others.

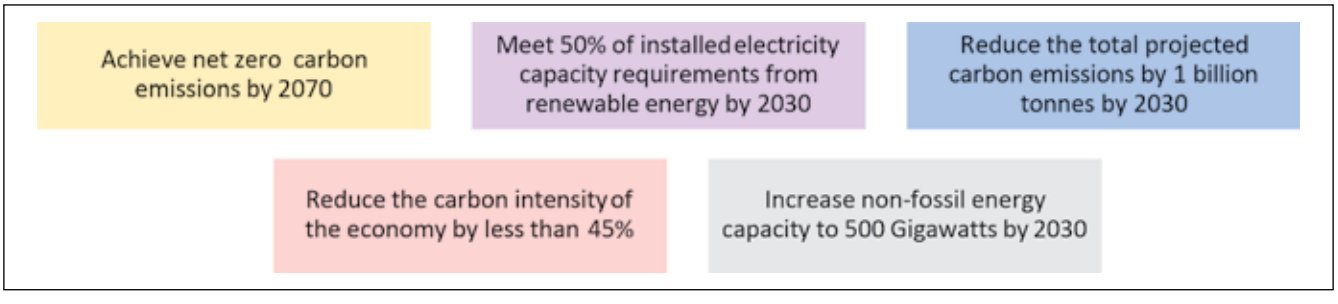
The developed countries have fell short of their promise of delivering financing equivalent to US$ 100 billion a year to developing countries by 2020, a target set back in 2009. The UK COP26 Presidency, in this regard, has published a Climate Finance Delivery Plan in October 2021, that commits to meeting the missed US$ 100 billion goal by 2023. The plan is being jointly developed by UK, Canada, and Germany for the developed nations. Furthermore, at the COP 27 summit, an agreement was reached for creation of a "loss and damage" fund to help vulnerable countries cope with the debilitating impact of climate change.

Contributors to Carbon Footprint

Presently, efforts towards combating climate change and promoting sustainability are centred around the ideas of decarbonisation and clean energy. Other aspects like resource extraction, use or consumption rates, waste generation etc are seldom talked about. Given that dependence on coal and other fossil fuels, globally is still witnessing an increasing trend, ways other than energy transition should also gain prominence.

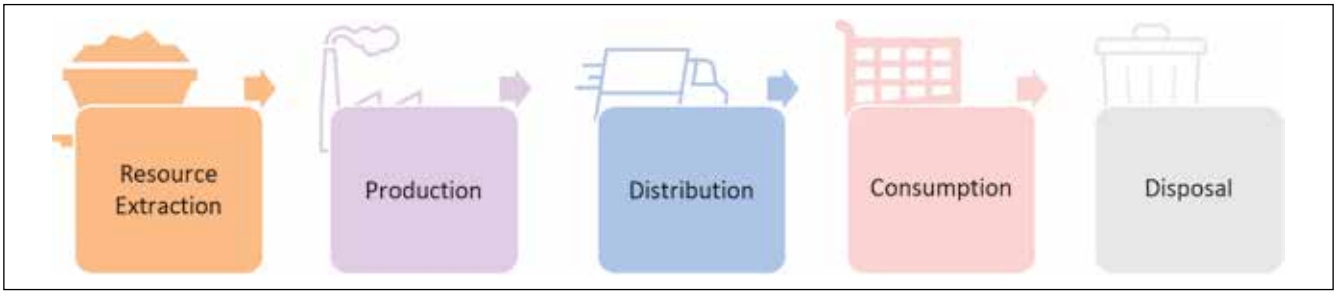
To illustrate, since 1970, the American population has grown by 60%, while consumer spending has seen a disproportionate rise of 400%. This trend, common for economies with burgeoning middle class is emerging because the growth rate of resource extraction is outpacing improvements in efficiency and recyclability by two to three times and also because human activities tend to be focused more towards generating new resources

Exhibit 3: India's New Climate Targets



Source: Government of India

Exhibit 4: Linear Economic Model



Source: India Exim Bank Research

rather than ensuring optimum utilisation of the resources already present[24].

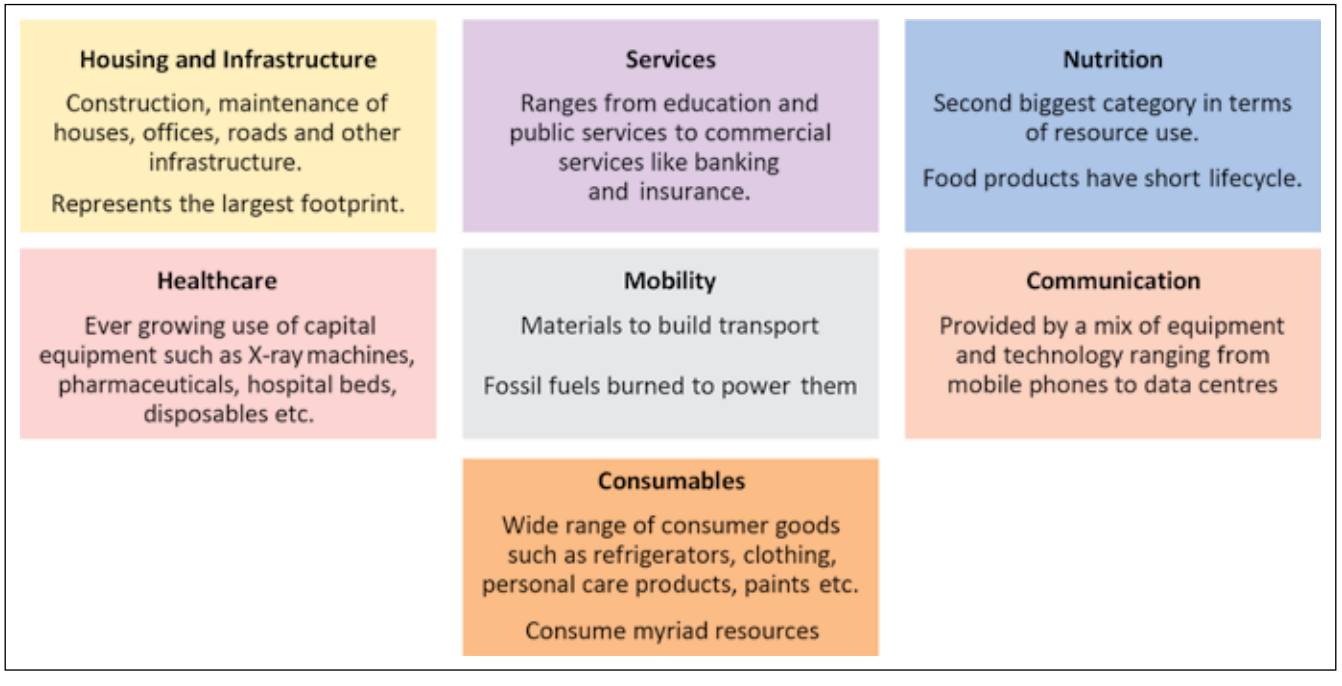
Presently, we practice a 'linear economic model' for consumption based on a "take-make-consume-throw away" pattern wherein resources are extracted, turned into products, used, and discarded. In this system, limited raw materials eventually run out; waste accumulates, leading to either expenses related to disposal or else pollution; and manufacturing processes are not usually designed in a way that wastage is minimised (Exhibit 4). Thus, linear economy is highly inefficient, causing depletion of earth's limited resources, creating gigantic volumes of waste, and leading to alarmingly high emissions of GHG.

The linear economic model in practice, although has enabled strong growth and creation of wealth, it has encouraged excessive consumption leading to generation of unfathomable amount of waste.

According to the Circularity Gap Report 2021, "in the past half-century, the world's population has more than doubled, yet the amount of material flowing through the economy has more than tripled, from 27 billion tonnes in 1970 to 84 billion tonnes in 2015 and 100 billion tonnes in 2021. Shockingly, the mass of human-made things, from pavements to apartments to phones, has started to outweigh all living beings and biomass. These trends are steering the earth towards a 3-to-6-degree temperature increase since the 1900s. If business-as-usual continues, it is estimated that GHGs emissions will reach 65 billion tonnes by 2030".

To get a more holistic idea of how human activities in the present linear economy are creating more GHG emissions, the Circularity Gap Report 2022 maps the seven societal needs with the quantum of emissions they produce (Exhibit 5).

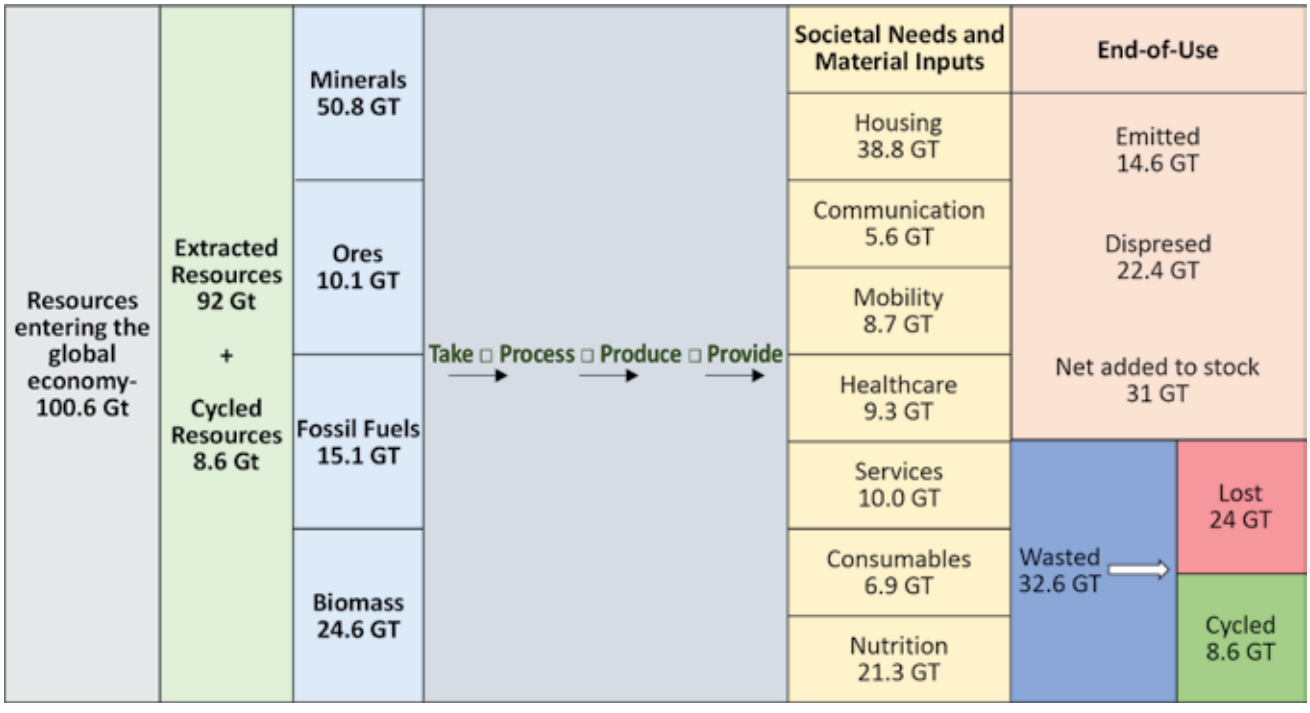
Exhibit 5: Seven Societal Needs and Wants



Source: Circularity Gap Report, 2022

[24] Circularity Gap Report 2022. https://www.circularity-gap.world/2022

Exhibit 6: Material Footprint and Carbon Emissions of Societal Needs and Wants



Source: Adapted from Circularity Gap Report, 2022

According to the Circularity Gap Report 2022 estimates, per year, 92 billion tonnes of resources are extracted, globally[25]. Out of these, it is estimated that mere 8.65 billion tonnes of resources are cycled, making the total material used as inputs into the economy equivalent to 100.6 billion tonnes. The housing needs account for the maximum material footprint (38.5%), followed by nutrition (21%), services (9.9%), and healthcare (9.3%). Nutrition needs which entail agriculture activities for obtaining crops and livestock have the second biggest resource requirement. Besides, food products have short lifecycles as they are consumed quickly after production.

As per the report, 70% of GHGs emitted are directly linked to material handling and use and 80% of all emissions are linked to housing, mobility, and nutrition. Mobility has the largest emission footprint at 17.1 Gt due to fossil fuel use across passenger and freight transport. Housing has the second largest quantum of emissions followed by nutrition which contributes 10 Gt emissions annually.

Towards Circular Economy

As observed, while energy transition is hugely important, it's not the only way to reduce carbon footprint and ensure a sustainable environment. Activities undertaken for fulfilling needs of nutrition, housing, services etc. also contribute considerably to generation of GHG emissions and waste. Therefore, it is imperative to adopt a more rounded approach to mitigate the effects of climate change.

Circularity gives the tools to transform our linear economy into one where waste and pollution are eliminated, products and materials are reused, and nature is regenerated.

Circular economy (CE) is a "model of production and consumption, which involves sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and products as long as possible"[26]. It provides a framework for decoupling growth from material extraction, i.e., it can create the conditions for sustainable development by meeting the needs

[25] Reference year- 2017

[26] European Parliament. (2022).

of the growing population without relying on the use of primary resources.

In a CE, materials for new products come from old products by reusing, remanufacturing, or recycling as much as possible. In this way, the life cycle of products is extended (Exhibit 7).

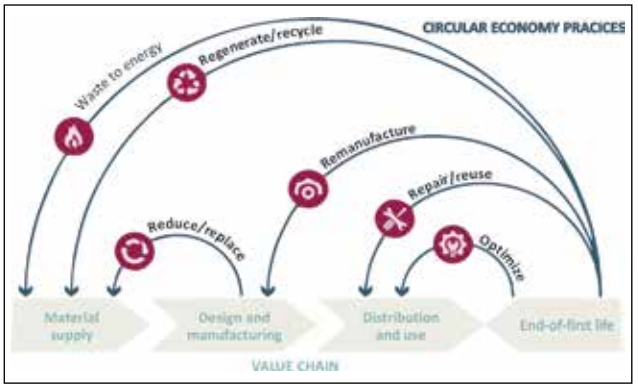
Exhibit 7: Depiction of Circular Economy

Source: European Parliament

According to UNIDO, the CE "emphasizes the creation of feeder loops that transform waste into new inputs for production at all nodes within the value chain". Beyond production, it also means changing the way humans consume and use goods and services and questions the present state of consumerism in the society. The CE is nature's equivalent of 'living within your means.'

Thus, it is fundamentally different from the linear economic model where resources are disposed of after a single use (Exhibit 8). The core principles of a CE are reduce, replace, regenerate biomass, repair, refurbish, re-manufacture, reuse and recycle, product-as-service, and waste-to-energy. This enables products to have additional lifetimes or be reused as an input material, part or component, or energy source.

Exhibit 8: Linear Economy vs Circular economy



Source: UNIDO

Benefits of a Circular Economy

Will keep a check on global temperature rise

Incorporating CE solutions to Nationally Determined Contributions (NDCs) can prove to be an effective way to keep global temperature rise below 2 degrees celsius.

Presently, the world faces an alarming situation. A new milestone of 100 Gt material annual consumption has been reached and temperature has risen by over 1 degree.

It may be noted that when CE is enacted globally, it has the potential to close the emissions gap much before the present targets. The circularity gap report states that CE has the power to shrink global GHG emissions by 39% and cut virgin resource use by 28%. Thus, CE is a means to cut resource use and emissions and boost equitable societies.

Will play an instrumental role in achieving Sustainable Development Goals (SDGs)

CE can contribute both directly and indirectly in achieving the various SDGs adopted by the United Nations member states in 2015. These SDGs are a blueprint to achieve a better and more sustainable future as they aim at addressing the many global challenges that the world faces presently, climate change being one of them.

Directly, CE will help achieve SDG 12 (Sustainable consumption and production) by incorporating its core principles in the production and consumption processes.

Indirectly, it can contribute towards achieving several goals such as SDG 2 (Zero hunger) by reducing food waste and ensuring food security, SDG 3 (Good Health and well-being) through reduction of waste and pollution, SDG 6 (Clean water and sanitation) through efficient water supply chains and reduction of pollution, SDG 8 (Decent work and economic growth) by boosting employment and ensuring better working standards. The other SDGs that CE can help in realising are SDG 9 (Industry, innovation and infrastructure), SDG 11 (Sustainable cities and communities), SDG 13 (Climate Action), SDG 14 (Life below water), and SDG 15 (Life on land). (Exhibit 9)

Will lead to economic gains

By incorporating and intensifying practices of reuse, repair, remanufacturing, and recycling, CE helps in improving resource productivity. It also helps in cost savings as it leads to efficient use of resources.

For instance, a study undertaken by McKinsey and Ellen MacArthur Foundation has demonstrated that by adopting CE practices, Europe can boost its resource productivity by 3% by 2030 and generate cost savings of €600 billion a year and €1.8 trillion more in other economic benefits[27].

Further, new business models such as "product-as-service" create additional economic opportunities (Exhibit 10). For example, the introduction of battery swapping policy and interoperability standards will give a string impetus to the Electronic Vehicle ecosystem in India. By recognising battery or energy as a service, the private sector will be encouraged to develop sustainable business models and use of EVs would intensify.

Exhibit 10: Economic Grains from Cicular Economy

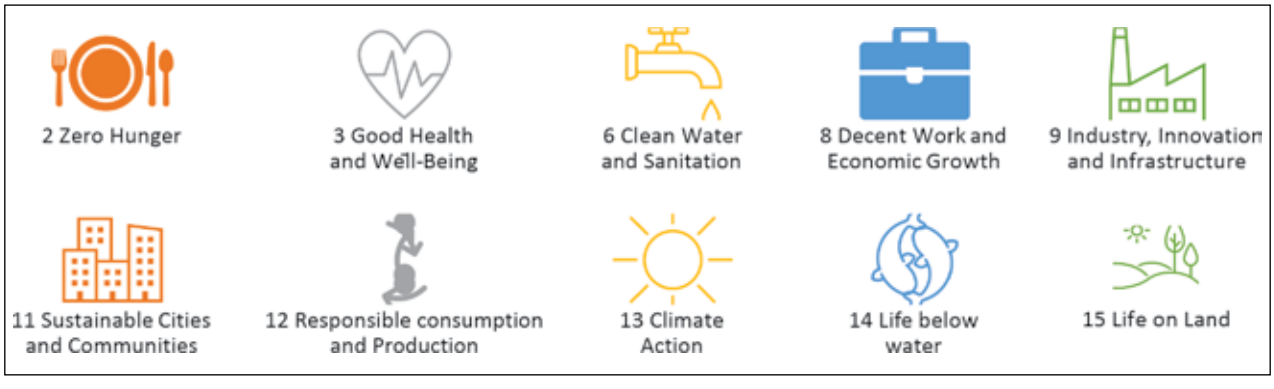
Economic Outcomes of a Circular Economy	Reduced production costs and improved competitiveness
	New business activities and models
	New markets and investment opportunities
	Increased long term availability of supply

Source: India Exim Bank Research

CE helps to reduce production costs and costs originating from resource extraction and generation by reducing resource dependency and resource use.

For example, Thousand Fell, a shoe manufacturer makes shoes using sustainable materials such as coconut husk, sugar cane and recycled plastic bottles. As these products can be cheaply procured, it promotes sustainability and at the same time reduces the production costs.

Exhibit 9: SDGs Pertaining to Circular Economy



Source: UN

[27] McKinsey Sustainability (2017). Mapping the Benefits of a Circular Economy.

CE also encourages adoption of economically viable methods of reducing pollution, and techniques for processes such as separation of harmful and reusable waste material. These benefits extend to individual firms as well as to industrial sectors and countries at the macro-level.

On an international level, the CE facilitates the exchange of goods across borders by harmonising standards that enable trade of recycled products or by-products that would otherwise not have any utility.

For example, since the late 1990s, exports of plastic waste from developed economies to developing countries has been increasing. In 2017, however, China imposed an unprecedented ban on imports of most plastic waste. In the presence of CE standards among the countries, the much-needed trade of plastic waste and other such non-biodegradable materials can take place. It also gives developing countries opportunities to deepen their participation in Global Value Chains.

Circular Economy will improve social welfare

The CE offers a plethora of social benefits, particularly in low-income economies.

Firstly, circular economy will lead to net creation of jobs such as in the fields of recycling, services like repair and rental, or in new enterprises aiming at achieving innovation in the use of materials.

According to ILO projections, under a CE scenario, worldwide employment would grow by 0.1% by 2030 in comparison with a business-as-usual scenario[28]. It will also lead to better health and working conditions for workers presently working in an informal environment. For example, around 15 million people globally work as waste pickers, collecting reusable or recyclable materials from garbage[29].

[28] ILO. (2018). World Employment and Social Outlook 2018 – Greening with jobs.
[29] Ibid.

Exploring new ways of treating and reusing waste through greater use of technology and standardisation of practices would ensure induction of informal waste pickers into a formal setup, thereby leading to a safe working environment and better quality of life.

CE will also help in ensuring food security. According to Food Waste Index Report 2021, food waste accounts for about 8% of global anthropogenic GHG emissions. Food waste occurs at retail, food service and household level due to factors like poor handling, inadequate transport or storage, lack of cold chain capacity, extreme weather conditions, cosmetic standards, and lack of planning among consumers. Reducing food lost or wasted would translate into more food for all, less GHG emissions, less pressure on environment, and increased productivity and economic growth.

CE can enable utilisation of opportunities for efficiency gains along the entire food chain such as in reducing post-harvest losses in storage or instilling habits in consumers that ensure less wastage. Myriad approaches including traditional practices such as systematic crop rotation can be adopted along with focus on innovation, use of technology and inclusion of new production processes.

Thus, transition from a linear economy to CE can help ensure greater food security and reduced GHG emissions,

Similarly, transition to a CE would help protect human health and biodiversity, put a check on unnecessary consumption and can lead to equitable distribution of resources.

Scope of the Study

The world today is on the verge of irreversible damage caused by human-induced climate change. The earth's temperature has risen by 1.1 degrees Celsius due to human activities, threatening the existence of a wide species of flora and fauna. There have been more frequent and intense droughts, storms, heat waves and forest fires; sea levels have

risen; and melting glaciers and warming oceans are leading to destruction of habitats.

According to the United Nations, ours is the last generation that can prevent irreparable damage to the planet. Thus, this calls for urgent global action that focuses on systemic changes in the society ranging from transition to clean energy and sustainable production processes to more responsible consumption patterns and minimal wastage of resources.

Existing literature points at the powerful role circularity can play in transforming our linear economy into one where waste and pollution are eliminated, products and materials are reused, and nature is regenerated.

The Study thus makes an attempt to shed light on the role circularity can play in ensuring a sustainable future and possible ways in which India can transform from a linear economy into a circular economy. The Study starts with explaining the concept of circularity and the positive impact it can have on the society.

The second chapter discusses the detrimental impact of prevailing linear practices in select sectors on the environment as well as the economy in the long run.

The third section discusses the present state of circularity in India, especially with regards to international trade.

Next, policy framework of select countries for enabling transition to a circular economy is discussed.

The study concludes by highlighting a few possible strategies that India could adapt to enable a rapid and smooth transition to circular economy, while bringing forth the benefits that will ensue.

Chapter

Need for Circular Economy: Sectoral Analysis

"The Earth has enough for everyone's need but not for everyone's greed"

- Mahatma Gandhi

From the eighteenth to present century, industrialisation has advanced at an astonishing pace. Seen as a barometer of economic progress and development, industrial growth is inevitable for the fulfilment of society's needs. However, the linear processes currently in practice are, as a matter of fact, acting against the societal interests. This section looks at the prevailing production practices and their deleterious consequences in select sectors.

1. Textiles & Apparels

The global apparel market was valued at US$ 1.5 trillion in 2021, engaging more than 300 million people along the value chain. Clothing production has approximately doubled in the last 15 years, while the duration for which clothes are worn before disposal has fallen by almost 40%[30]. By 2030, the global apparel and footwear industry is expected to grow to US$ 3.3 trillion in value[31] from the current estimated market size of US$ 1.8 trillion[32].

Snapshot of India's Textiles and Apparels Sector

Textiles and apparel industries rank among the top five industries in India. Textiles industry ranks third in terms of factories with a share of 7.6% in total operational factories in India and second in terms of employment, engaging 10.8% of total employed people. Similarly, apparels sector ranks third in employment, engaging 7.6% of total employed people.

The value of products and by-products manufactured in the textiles sector and apparels sector has increased by a CAGR of 8.9% and 12.9% during 1997-98 to 2017-18, respectively. There has been a commensurate rise in materials consumed as evident by the CAGR of 9.4% and 9.7% in the sector, respectively, during the period. Materials consumed include the total value of raw materials, components, chemicals, packing materials and stores that went into the production process.

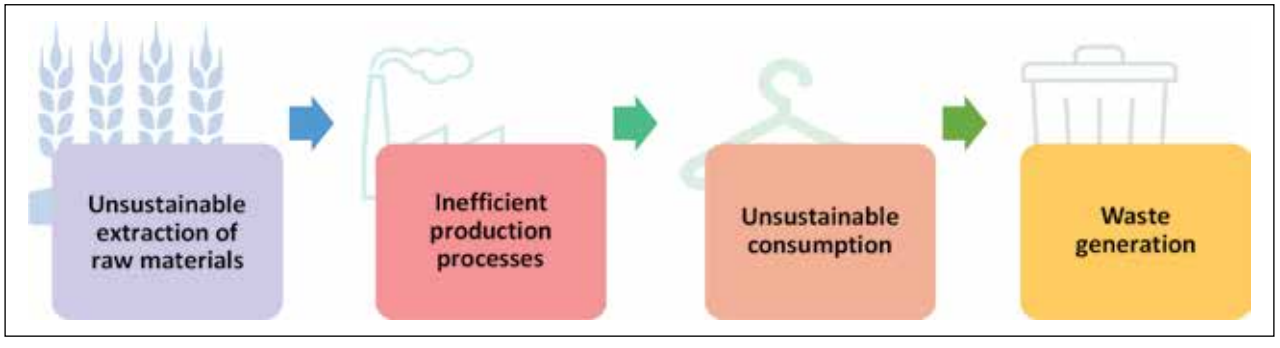
[30] Fashion and the Circular Economy, Ellen Macarthur Foundation
[31] Pulse of the Fashion Report
[32] Expert Market Research

Table 1: Key Indicators of the Textile and Apparels Sectors

Textiles							
Indicator	**Unit**	**1997-98**	**2002-03**	**2007-08**	**2012-13**	**2017-18**	**CAGR**
Number of factories	Numbers	12,639	12,764	12,859	18,468	17,958	1.8%
Materials consumed	₹ billion	431.6	508.4	999.2	1,892.1	2,584.9	9.4%
Products and by-products	₹ billion	643.7	747.3	1,415.7	2,664.2	3,486.5	8.9%
Apparels							
Indicator	**Unit**	**1997-98**	**2002-03**	**2007-08**	**2012-13**	**2017-18**	**CAGR**
Number of factories	Numbers	3,191	3,307	3,653	9,275	10,498	6.1%
Materials consumed	₹ billion	62.1	100.9	166.9	481.0	622.0	9.7%
Products and by-products	₹ billion	100.3	166.4	295.0	794.1	1,132.8	12.9%

Source: Annual Survey of Industries; India Exim Bank Research

Exhibit 11: Linear Model in Textiles and Apparels Sector



The Fashion industry currently is operating on a linear model right from material extraction to end disposal and there are lot of challenges in this model, at each stage.

Unsustainable extraction of raw materials- The linear model starts with extraction of raw materials, most of which are synthetics made from oil. The rest are made of natural fibres, majorly cotton. To illustrate, approximately 90% of clothing sold in the United States is made with either cotton or polyester[33]. While polyester is derived from oil, cotton requires large amounts of water and pesticides to grow.

According to the Ellen Macarthur Foundation[34], the textile and apparels industry uses 98 million tonnes of non-renewable resources every year. As the industry continues to expand, it raises concerns about the continued availability of resources as the rate of replenishment of these resources is much slower.

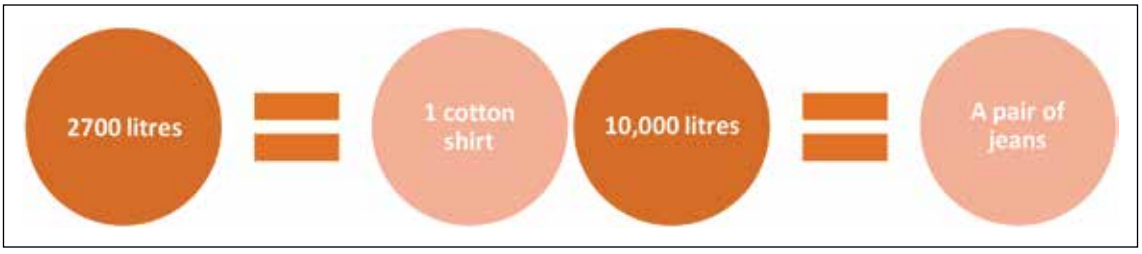
India is the largest producer of cotton globally. However, according to Water Footprint Network's research, it takes 22,500 litres of water to produce 1 kg of cotton in India as compared to the global average of 10,000 litres. Given that most districts in India face water scarcity in the range of 20-80%[35], this is going to put huge strain on groundwater reserves.

[33] Bick,R., Halsey, E., & Ekenga, C. The global environmental injustice of fast fashion

[34] A New Textiles Economy: Redesigning Fashion's Future

[35] Centre for Responsible Business (2021). Wastewater reuse – Strategy for sustaining the rich tradition of textiles in India.

Exhibit 12: Excessive Water Usage in Manufacturing Processes of Clothing Globally

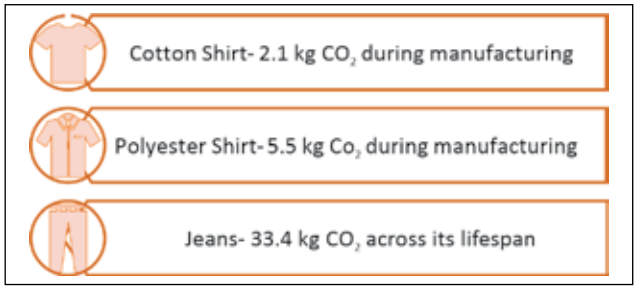


Source: ActNow for Zero-Waste Fashion (2019), United Nations

Inefficient production processes- The processes followed in the sector presently are taking huge toll on the environment.

- Carbon emissions- The fashion industry is responsible for 10% of global greenhouse gas emissions[36]. With the industry concentrated in Asia, a region highly dependent on coal and natural gas for electricity generation, the current pace of activity is expected to lead to a considerable rise in greenhouse gas emissions in the region. Under a business-as-usual scenario, it is forecasted that by 2050, textiles and apparel industry will use up to a quarter of world's carbon budget[37].

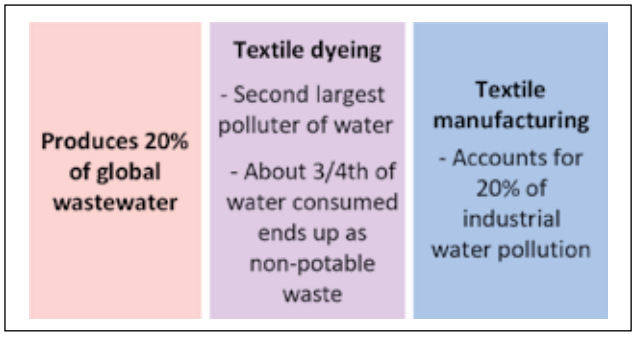
Exhibit 13: Carbon Emissions of Clothing Items



Source: Materials Systems Laboratory (2015)

- Chemicals and Water Pollution- Chemicals are used extensively during the life cycle of textile and apparel manufacturing. Approximately 60% of all materials such as polyester, acrylic and nylon textiles, used by the apparel industry are made from plastic[38]. Every time they are washed, they shed tiny plastic fibres called microfibres. As a result, half a million tonnes of microfibres are being dumped into the ocean every year[39].

Exhibit 14: Fashion Industry and Water Pollution



Source: Digital Science (2022); Vogue (2019)

Unsustainable consumption- As per World Economic Forum[40], global consumption of apparel will rise from 62 million tonnes in 2019 to 102 million tonnes in 10 years.

India too is witnessing a tremendous change in consumption patterns. According to World Resources Institute (WRI), Indians increased their spending on clothes by 181% in 8 years - from ₹1,924 billion in 2010 to ₹5,408 billion in 2018[41].

[36] World Bank. (2019) How Much Do Our Wardrobes Cost to the Environment?
[37] UNEP. (2018). Putting the brakes on fast fashion.
[38] UNEP. (2019). Fashion's tiny hidden secret.
[39] Ibid.
[40] WEF. (2019). 7 ways to break the fast fashion habit - and save the planet
[41] WRI. (2019). Circular Fashion: Rethinking the way forward for India's fashion industry

Box 1: Noyyal River in Tirupur: An Environmental Dark Spot

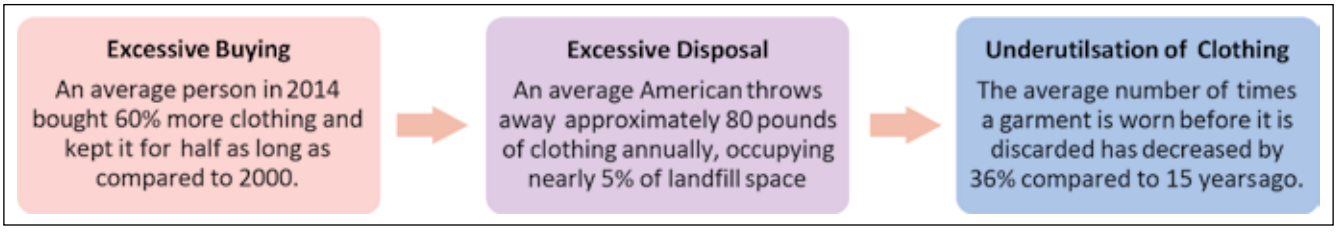
Located in Tamil Nadu, Tirupur is India's largest knitted garment export hub and is popularly called the T-shirt city. It houses over 1500 domestic units, 1100 export-oriented units and around 3000 allied units. However, the commercial activity in the city has led to serious environmental concerns.

With bleaching and dyeing being one of the main operations of factories located in the city, it is estimated that about 1500 tonnes of coloring agents are used by dyeing units in the region each year. It is commonplace for the dyeing and bleaching units located in the city to discharge dangerous chemicals effluents directly into the Noyyal river.

The toxins flowing in the river have caused irreparable damage to the agricultural fields, located along the river. From a seasonal river, it has turned into a perennial carrier of untreated effluents and sewage. This has severely affected the farmers' livelihoods as the impact of pollutants since 1990s has led to ecological transformation of the area whereby as compared to a diverse basket of crops that was grown here earlier, the river can now only support a few crops such as maize and coconuts.

Source: India Exim Bank Research

Exhibit 15: Changing Consumption Trends



Source: Ellen Macarthur Foundation. (2017).

Waste generation- Apparel sector accounts for 92 million tonnes of textile waste every year[42]. One of the major contributing factors is fast fashion with estimates suggesting that more than half of fast fashion produced is disposed of, in under a year. It may be further noted that less than 1% of material used to produce clothing is recycled into new clothing leading to more than US$ 500 billion of value lost every year[43]. The mounting waste is not only leading to higher environmental costs, but also high economic costs related to disposal.

In India, more than 1 million tonnes of textiles are thrown away every year, with most of this coming from household sources, according to the Indian Textile Journal. Textile waste accounts for about 3% by weight of a household bin and is the third-largest source of municipal solid waste in India[44].

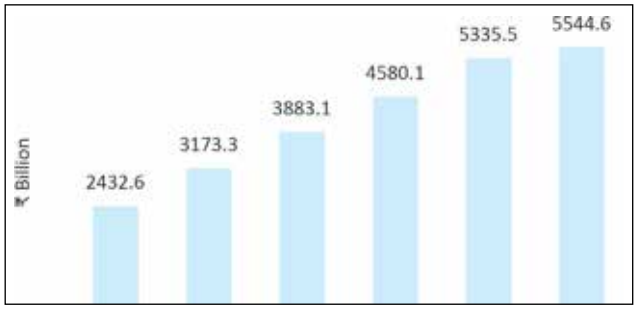
2. Electronics

Electronics hardware industry is globally the largest and fastest growing industry. The electronics sector in India has also witnessed impressive growth, with its share in global electronics manufacturing up from 1.3% in 2012 to 3.6% in 2019[45]. Production of electronic goods has increased from ₹2432.6 billion (US$ 37 billion) in 2015-16 to ₹5544.6 billion (US$ 74.7 billion) in 2020-21, a CAGR of 17.9%. The growth may be partly attributed to the strong policy support the sector has received under the

[42] Global Fashion Agenda and The Boston Consulting Group, Inc. (2017)
[43] Ellen Macarthur Foundation. (2017). A new textiles economy: Redesigning fashion's future.
[44] Business Standard. (2021). Climate Change: From H&M to Zara, how fast fashion hurts the environment
[45] Invest India

aegis of Make in India and Digital India programmes of Government of India.

Figure 5: Electronics Production in India



Source: MEITY

Within the sector, India's performance in the mobile phones segment is noteworthy. India has emerged as the second largest mobile handset manufacturer and the second largest smart phone market globally. Valued at US$ 30 billion in 2020-21, mobile manufacturing in the country has seen a manifold increase, from 6 crore units in 2014-15 to 29 crore units in 2020-21.

However, the rising demand for electronics in the country has also impacted the import bill. Electronics is India's third largest imported category, with the imports rising from US$ 42 billion in 2016-17 to US$ 71.2 billion in 2021-22. Out of the domestic consumption of about US$ 180 billion worth of electronics, approximately 92% is catered by global brands and only 8% by Indian brands[46]. By 2025, the demand for electronics hardware is expected to further rise to about US$ 400 billion in India[47].

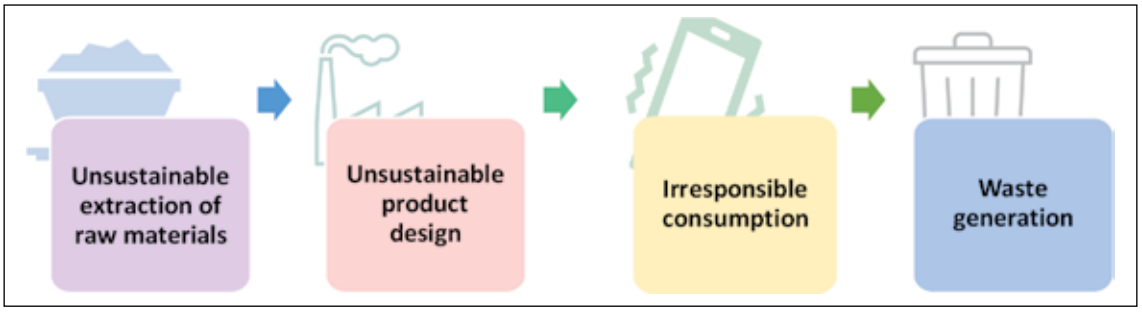
Unsustainable extraction of raw materials- Minerals such as iron, copper, silver, gold, aluminium, manganese, chromium, and zinc along with various rare earth elements serve as raw materials for production of electronics. Mobile phones, for example, contain on average over 30 different minerals procurement for which the use of virgin resources is predominant. This is worrisome as the rate of extraction of these minerals is considerably higher than the rate of their formation in nature.

Table 2: Select Minerals used in Mobile Phones

Mineral	Use
Germanium	Battery, display, electronics and circuitry, and vibration components
Graphite	Battery anodes
Indium	Liquid crystal displays
Lithium	Battery cathodes
Potassium	Screen glass
Rare-earth elements	LED phosphors, screens, speakers, and vibration motors
Silicon	Semiconductors
Gold	Circuit board
Cobalt	Batteries
Nickel	Electrical connections, capacitors and batteries.
Silver	Circuit board
Zinc	Circuit board

Source: U.S. Geological Survey; National Museums Scotland

Exhibit 16: Linear Model in Electronics Sector



[46] Economic Times. (2022), How electronics sector can be the next big thing for Indian MSME?

[47] Ministry of Electronics & Information Technology Annual Report 2021-22

In line with the global practices, in India too, mainly virgin resources go into making electronics. However, India lacks many of the materials required for production of electronics. It has high import dependence for procurement of many minerals essential for production of electronics such as copper, nickel, and cobalt. The situation is particularly concerning for procurement of rare-earth elements. India is severely dependent on a handful of countries like China for meeting the demand which is currently home to the world's biggest rare-earth reserves, holding roughly 37% of the global reserves. With increasing supply chain vulnerabilities and a shaky geopolitical landscape, the current procurement processes seem unsustainable.

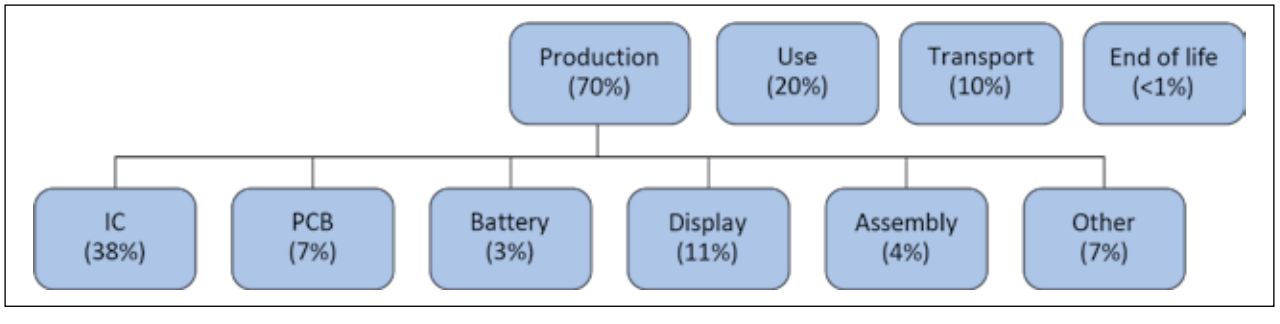
Unsustainable Product Design- With the electronics sector witnessing rapid changes in the last two decades, the product designs are becoming increasingly impenetrable. The products are difficult to disassemble for purposes such as repair and recycling because of manufacturing practices like fusing of metals, sealing the batteries etc. This has led to detrimental environmental and consumption effects. Besides, the charging ports vary across electronic devices necessitating the use of different chargers. For example, while Android smartphones have USB-C charging ports, Apple phones come with the proprietary lightning port requiring different chargers. This has aggravated the problem of accumulation of e-waste. Built-in obsolescence is another problematic phenomenon globally. It refers to the practice of encouraging buyers to purchase new items by artificially reducing the lifespan of products. It is observed that with the launch of new models, the companies tend to cease providing technological support or features in older models because of which it becomes inevitable to upgrade to newer versions.

The manufacturing processes also have negative externalities on the environment. Around 70% of the estimated 70 kg CO_2e emissions produced by a smartphone during its lifetime are released during the manufacturing process. Integrated and printed circuit boards (ICs and PCBs) are generally responsible for most of this environmental burden[48].

Irresponsible Consumption- These problematic consumption patterns in electronics are reflected in three aspects, namely, non-reparability, functional obsolescence, and the power of marketing. The plummeting manufacturing costs of electronics coupled with high costs of repair have enabled a culture of frequent buying. Besides, the economics of gadgets encourages disposal. For example, in some cases, buying a new printer is cheaper than buying a set of new ink cartridges.

Waste Generation- Electronics have become the world's fastest-growing waste stream. Of the

Exhibit 17: Carbon Footprint
(in kg CO_2 equivalent) Generated over a Smartphone Lifetime

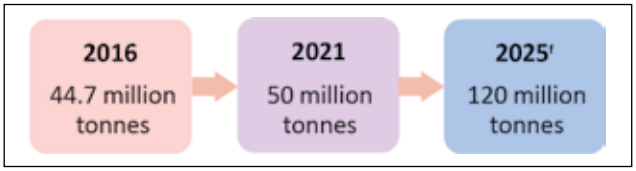


Source: MDPI, 2021

[48] Moreau, N.; Pirson, T.; Le Brun, G.; Delhaye, T.; Sandu, G.; Paris, A.; Bol, D.; Raskin, J.-P. (2021). Could Unsustainable Electronics Support Sustainability? MDPI

total e-waste, only around one-fifth is recycled in appropriate conditions[49].

Exhibit 18: E-waste Generation



Source: E-waste Monitor Reports

This not only has created a grave problem of accumulation of toxic waste in landfills but has also led to colossal losses due to lack of realization of value from the waste. E-waste contains many high-value and scarce materials, such as gold, platinum, cobalt, rare earths, and high quantities of aluminium and tin, making its annual worth over US$ 62.5 billion[50]. According to a report by Platform for Accelerating the Circular Economy (PACE) and World Economic Forum (WEF)[51], as much as 7% of the world's gold may be contained in the accumulated e-waste, with 100 times more gold present in a tonne of e-waste than in a tonne of gold ore.

With increasing consumption, the problem of inadequate e-waste disposal is also exacerbating in India. As per Global E-Waste Monitor 2020 report, India generated 3.2 million tonnes of e-waste in 2019, ranking third after China (10.1 million tonnes) and the U.S. (6.9 million tonnes). Further, as per a report by the Central Pollution Control Board, India collected only 3.5% and 10% of the e-waste generated in the country for recycling in 2017-18 and 2018-19, respectively[52]. The huge gap between generation and recycling of waste in India is worrying.

Box 2: Working in a toxic environment- The case of Seelampur

The e-waste dismantling market in Seelampur is one of the largest informal e-waste markets in India. The market houses over 50,000 people engaged in extraction of metals such as gold, silver, copper, tin, titanium, and palladium from e-wastes. However, the market is rife with malpractices such as child labour, unsafe working conditions, and lack of adherence to law.

For extracting materials, processes such as acid burning, and open incinerations are practiced that pose health and environmental hazards. The people working in the e-waste units also neither have the license nor the skill to handle e-waste. They do not have access to protective equipment and the prescribed techniques. For example, in the absence of machines and adequate technology, the wires are burnt for extracting metals from mortars and compressors. The burning of PVC present in the electric wires releases toxic gases which poses serious health risks.

Although, the prevailing E-Waste Management Rules, 2016 have laid down the procedure for safe treatment of e-waste by authorized dismantlers and recyclers only, a study by Toxics Link found that 92% of informal processors are unaware of the Rules. The study also found that at least 15 e-waste processing hotspots were operating illegally in Delhi.

Source: The Probe[53]; Toxics Link[54]

3. Automobiles

Automobiles industry plays an integral role in the economic development of the country. It is the fifth largest industry in terms of output and Gross Value

[49] World Economic Forum. (2018). How do we tackle the fastest growing waste stream on the planet?;
[50] UNEP (2019). Time to seize opportunity, tackle challenge of e-waste.
[51] PACE and WEF. (2019). A New Circular Vision for Electronics- Time for a Global Reboot.
[52] Down to Earth. (2021). India collected just 3% e-waste generated in 2018, 10% in 2019: CPCB report.
[53] The Probe. (2022). Seelampur: Soaring e-waste in India's largest e-waste market puts lives at risk.
[54] Down to Earth. (2022). Measuring emissions from vehicles

Added, contributing 7.7% to India's total output and 7.1% to the Gross Value Added. India is the largest manufacturer of two-wheelers and three-wheelers and the fourth largest manufacturer of passenger cars in the world. Steady economic growth in India is leading to an insatiable demand for vehicles. The annual car sales in India are projected to increase from the current 3.5 million to about 10.5 million by 2030[55].

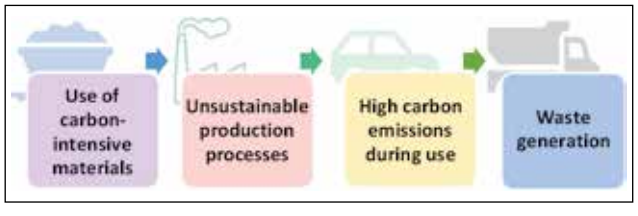
Table 3: Key Indicators of the Automobiles Sector

Indicator	Unit	1997-98	2002-03	2007-08	2012-13	2017-18	CAGR
Number of factories	Numbers	1,916	2,902	3,310	5,558	6,182	6.0%
Materials consumed	₹ billion	183.2	384.2	1,118.9	2,749.6	4,250.8	17.0%
Products and by-products	₹ billion	282.4	530.1	1,495.0	3,658.6	5,789.0	16.3%

Source: Annual Survey of Industries; India Exim Bank Research

However, the transportation sector is one of the fastest-growing sources of carbon emissions in India. This is because of the preponderance of the linear model in production and consumption of automobiles, both in India and globally.

Exhibit 19: Linear Model in Automobiles Sector



Use of carbon-intensive materials- Manufacturing of a conventional car requires a tremendous number of materials such as steel, aluminium, copper, magnesium, plastics, glass, and carbon fiber, among others. As materials manufacturing is a carbon-intensive process, involving mining/ extraction; refining; transportation; and processing, high material usage causes excessive pollution. Currently, production of materials accounts for 18–22% of the emissions generated by cars with Internal Combustion Engines (ICE)[56].

Exhibit 20: Use of Steel in Automobiles

Carbon Emissions produced by steel in automobile industry are alarming	With about 30 steel grades used in automobiles, almost 40-60% of light vehicles mass is composed of steel.
	75% of steel used in an automobile is virgin steel.
	In 2020, on average, every tonne of steel produced led to 1.89 tonnes of CO2 emissions, representing 7-9% of global CO2 emissions.

Source: Yale University[57]; World Steel Association[58]

Besides steel, there is also excessive use of other virgin metals such as aluminium and materials like plastics and solvent-borne paints in the industry. Furthermore, the carbon footprint of materials going in the production of battery-electric vehicles (BEVs) is also considerable. In fact, a typical electric car requires six times the mineral inputs of a conventional car[59]. Production of BEVs is highly dependent on critical elements like lithium, cobalt, neodymium, and platinum, the extraction and processing of which have significant environmental and economic burden.

India's rapidly growing automobile industry requires vast mineral resources. India is deficient in many of these materials. Thus, as production increases, the economic and environmental costs of high material consumption will also swell.

Unsustainable Production Processes- Almost 15% of total vehicle-related CO_2 emissions arise during

[55] Down to Earth. (2022). Measuring emissions from vehicles in the real world: Policy steps in India.

[56] WEF Circular economy transportation action track.

[57] Yale University. (2020). Circular economy framework for automobiles Closing energy and material loops.

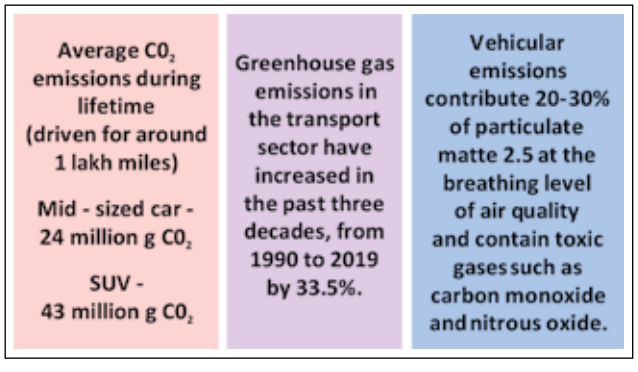
[58] World Steel Association. (2021). Climate change and the production of iron and steel.

[59] IEA (2021), The Role of Critical Minerals in Clean Energy Transitions.

the production processes[60]. Considerable energy, water and other resources are used in automobile production process. For instance, in the UK, the automotive industry in 2017 used 5.2 billion litres of water and produced over 1 million tonnes of CO2 equivalents[61]. The production of BEVs is even more energy intensive. Production of BEVs causes almost double the carbon emissions due to high energy requirements for battery production. It is thus estimated that due to increasing electrification of vehicles, emissions from material production may reach 60% of life -cycle emissions by 2040 as against 18% in 2020[62].

High Carbon emissions during use- The transport sector generates the largest share of greenhouse gas emissions (27% in 2020)[63]. This is because about 99.8% of the global transportation system is still powered by ICEs[64].

Exhibit 21: Carbon emissions in the Transport Sector



Source: Finold Jose, et al[65]; Fortune India

In India, on average, around 8% of total greenhouse gases emanate from the transportation sector. In Delhi, the share is much higher at 30%[66]. Cities in India like Delhi, Bangalore, Mumbai, and Kolkata have some of the highest sources of nitrous oxide in the country whose primary source is vehicular pollution. According to National Family Health Survey (NFHS)-5, only 8% of Indian households own cars. With car ownership expected to rise in the coming years, there may be grievous consequences on the environment.

Waste generation- According to estimates by Centre for Science and Environment (CSE), India will accumulate as much as 22 million end-of-life vehicles (17 million two-wheelers, 3 million passenger vehicles and others 2 million) by 2025. With India's recycling infrastructure still at a rudimentary state, the country is looking at a huge waste disposal problem. Furthermore, as the world undergoes a rapid transition to EVs, the problems related to disposal are going to get worse.

Lithium-ion batteries are not fully decomposed until 8-20 years after they are disposed as against their average life of 5-6 years. Inadequate recycling would not only result in increasing burden on landfills but also risk the stable supply of critical metals present in the battery. For instance, currently only 1% of neodymium has been ever recycled in the Europe.

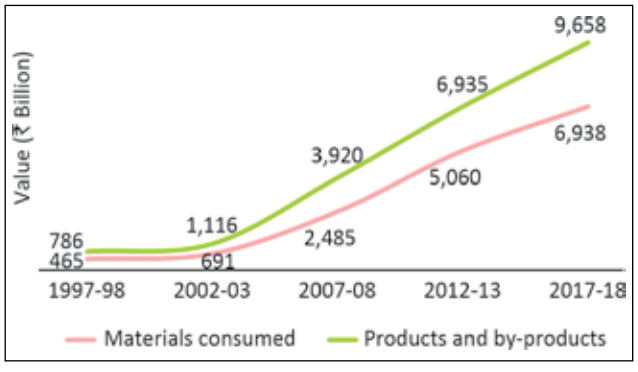
4. Metals and Mining

In 2019, the world mined 3.2 billion tonnes of metals. Iron ore constituted around 94% share in the total production while industrial metals and technology and precious metals represented around 6%[67].The demand for all major metals is expected to continue to grow exponentially over the 21st century. Notably, aluminium, copper, zinc and iron are anticipated to witness the highest demand over time[68].

[60] Demeri,M. (2013). Advanced High-strength Steels: Science, Technology, and Applications. ASM International.
[61] Capgemini. (2020). The Automotive Industry in the Era of Sustainability.
[62] World Economic Forum. (2022). 3 ways the circular economy is vital for the energy transition.
[63] United States Environmental Protection Agency
[64] Leach, F., Kalghatgi, G., Stone, R. and Miles, P.(2020). The scope for improving the efficiency and environmental impact of internal combustion engines.
[65] Finold Jose, et al.: Impact of Electric Vehicles Adaption on the Balance of Payment and Current Account Deficit in India
[66] Down to Earth (2022). Measuring emissions from vehicles in the real world: Policy steps in India.
[67] WEF. (2021). All the metals we mine each year, in one visualization. Industry metals refer to metals used in industries ranging from construction and agriculture to manufacturing and transportation. Technology metals are classified as relatively rare metals commonly used in technology and devices.
[68] Watari,T., Nansai, K. and Nakajima, K. (2021). Major metals demand, supply, and environmental impacts to 2100: A critical review.

The metals industry forms the backbone of manufacturing sector in India. The industry has the highest share in output (14%) and the second highest share in terms of net value added (11%) among all the industries[69]. Between 1997-98 to 2017-18, while production of basic metals has increased by 12 times from ₹786 billion to ₹ 9.7 trillion, material consumption in the industry has expanded by 15 times from ₹465 billion to ₹ 7 trillion.

Figure 6: Production and Materials Consumption in the Basic Metals Industry



Source: Annual Survey of Industries; India Exim Bank Research

Table 4: India's Production of Select Minerals (in million tonnes)

	2015-16	2016-17	2018-19	2019-20	2020-21	India's Share in Global Production
Iron	158.1	194.6	201.4	206.5	246.1	6.80%
Copper	3.9	3.8	3.7	4.1	4.0	0.10%
Bauxite	28.1	24.7	22.8	23.7	21.8	5.30%
Gold	0.6	0.6	0.5	0.6	0.6	0.04%

Source: Indian Bureau of Mines; CMIE Industry Outlook; British Geological survey; India Exim Bank Research

For a thriving industrial base, an uninterrupted flow of resources is inevitable. However, according to IMF, the current production rates of important metals like copper and lithium are inadequate to meet future demand[70]. The current linear model for production of metals threatens resource security.

[69] Annual Survey of Industries, 2018-19

[70] IMF. (2021). Metals Demand from Energy Transition May Top Current Global Supply.

Exhibit 22: Liner Model in Metals and Mining Sector

Environmentally Irresponsible Mining: The mining industry consumes up to 11% of the global energy use. Furthermore, 70% of the mining projects from the six largest mining companies operate in water stressed regions[71]. Production of mineral tailings[72], a worrisome by-product of mineral refining is increasing by 7 billion tonnes per year, with billions of tonnes already present. Long-term storage of such waste products is costly and harmful for the environment.

Box 3: Not so Clean Processes in Transition Towards Clean Energy

The market for Rare Earth Elements (REE), critical for developing clean energy applications, is dominated by China. However, the country's REE operations are causing "increasingly significant environmental problems" according to China's State Council. Mining and processing of REE has caused considerable damage to surface vegetation, led to soil erosion, pollution, and acidification, and has reduced food crop output.

The Bayan Obo mine in China is the largest REE mine in the world and one of the most heavily polluted areas in the world. The tailing pond produced by the mine stores about 70,000 tonnes of radioactive thorium. It lacks proper lining, resulting in seeping of toxic materials into groundwater and eventually into the Yellow River, a key source of drinking water. The sludge is moving at a rapid pace of 20-30 meters per year. There are several other mines in the country having grave environmental consequences.

Source: Harvard International Review

[71] World Bank. (2020). Minerals for Climate Action: The Mineral Intensity of the Clean Energy Transition

[72] Mineral tailings refer to a mixture of waste by-products generated when recovering minerals from their ores. After selective extraction of the desired materials, the residuals are combined to form the tailings stream Theses are conventionally stored above-ground behind earthen dams.

Polluting Manufacturing processes- Smelting uses about 4% of the world's energy and is responsible for about 7% of global greenhouse-gas emissions[73]. Besides, metal smelting and refining processes generate wastes that may contain hazardous metals, inter alia, lead, zinc, nickel, and mercury. Among all the industries, the iron and steel industry have the most energy demanding production process. Usage of coal in the sector is responsible for 7-9% of global CO_2 emissions[74]. As of 2019, 54% of CO_2 emissions in the steel sector were generated in China, followed by India (6.6%) and Japan (5.1%)[75].

Inadequate Waste management- Mining operations produce large quantities of waste rocks, which often contain little or no valuable minerals[76]. India's metals recycling rates are worryingly low. The overall metal recycling rate in India ranges from 20-25%, much lower than recycling rate of 90% in Scandinavian countries[77]. Some of the factors attributed to inadequate domestic metal recycling are informal and unorganised nature of the recycling industry; lack of sustained implementation of existing regulations; and lack of standardization of recycled products[78].

Table 5: Recycling Rates of Select Metals

Metal	Global Benchmark recycling rate	National Recycling Rate
Aluminium	98.5%	30%
Lead	>90%	85%
Copper	82%	20%
Zinc	>30%	10%

Source: National Non-Ferrous Metal Scrap Recycling Framework, 2020

[73] Mining.com (2021)
[74] IEA. (2020). Iron and Steel Technology Roadmap
[75] Global Efficiency Intelligence. (2022). Steel Climate Impact: An International Benchmarking of Energy and CO2 Intensities.
[76] Sustainable Minerals Institute. (2019). Re-Thinking Mining Waste through an Integrative Approach Led by Circular Economy Aspirations.
[77] Metalworking World Magazine. (2015). Early stages for India's metal recycling industry.
[78] National Non-Ferrous Metal Scrap Recycling Framework. (2020).

Consequently, the scrap demand is being met through imports. In 2021, despite being the second largest producer of steel, India was the second largest importer of iron and steel scrap with a share of 7% in world imports.

Summing up

The chapter documents the detrimental impact of prevailing linear practices in select sectors on the environment as well as the economy in the long run. In all the sectors covered, namely textiles and apparels; automobiles; electronics; and metals, the extraction processes for raw materials are found to be unsustainable. In the case of India, excessive reliance on cotton, a water guzzling crop in the textiles and apparels sector, predominant use of virgin resources in the electronics sector, preponderance of carbon-intensive materials in the automobiles sector and the environmentally irresponsible mining practices existing in the metals sector raise concerns about the continuous supply of resources and the increasing opportunity costs arising from inadequate use of secondary materials.

Many of the existing production models and practices also tend to be inefficient in terms of high carbon emissions, chemicals and water pollution, excessive use of materials and high wastage. For instance, as noted in the chapter, around 70% of the estimated 70 kg CO_2 emissions produced by a smartphone during its lifetime are released during the manufacturing process. Similarly, 20% of industrial water pollution may be attributed to textile manufacturing.

Not just manufacturing, the growing irresponsible consumption practices are also taking a toll on existing resources and contributing to strengthening of linear models across sectors. For instance, the frequent buying and disposing of electronics is leading to generation of enormous volumes of waste.

The more sobering issue is the underutilisation of this growing waste stream. In the clothing and apparel sector, lack of recycling and underutilisation

of the waste amounts to a loss of more than US$ 500 billion of value each year. Due to the lack of emphasis given to waste treatment in India, recycling rates in commodities such as apparels, metals and electronics are staggeringly low.

Thus, right from resource extraction to treatment of waste, the prevailing linear practices across the sectors need to be scrutinised and transformed to minimise pollution and waste creation and maximise social and economic gains.

Chapter

Circular Economy and International Trade

"There is no such thing as 'away'. When we throw anything away it must go somewhere."

- Annie Leonard

Circular economy cannot be strengthened in silos at the domestic level. International trade and global value chains play a key role in accelerating the transition towards circular economy. International trade fosters economies of scale which is integral for making the circular economy profitable and scalable. Economies of scale also incentivise investment and technological development. Circular economy related trade offers myriad economic opportunities by channelling waste and materials to countries where there is comparative advantage in processing and carrying out value extraction or addition in such materials.

Circularity can be incorporated at various levels along the product value chains (Exhibit 23). Trade in second-hand goods, although quite prevalent, remains hampered due to imposition of restrictions and barriers. This is because some of these goods are perceived to have undesirable impact on import markets. Trade in refurbished goods poses tremendous opportunities particularly for developing countries where such practices are prevalent domestically. However, the lack of standardisation and trade barriers have hitherto kept the potential unrealised.

Coming to trade in waste and scrap for recovery, there is growing awareness on the importance of treating waste as a resource and a major trading good. Trade in waste can provide potential opportunities to channelise waste to countries with comparative advantage in processing activities and thereby can help in boosting global recycling rates.

Exhibit 23: Linkages between International Trade and the Circular Economy

Source: OECD

Trade in secondary raw materials[79] differs from trade in waste[80]. The recycling of waste into secondary raw materials takes place in the importing country in the case of export of waste whereas in the case of exports of secondary materials the valorisation of waste takes place in the exporting country itself. For instance, exports of gold extracted out of e-waste would be categorised as export of secondary material whereas export of e-waste for extraction of gold and other minerals in the importing country would be categorised as exports of waste.

[79] 'Secondary raw materials' are recycled materials that can be used in manufacturing processes instead of or alongside virgin raw materials.

[80] Waste trade is the international trade of waste between countries for further treatment, disposal, or recycling. Often, toxic or hazardous wastes are exported by developed countries to developing countries, such as those in Asia Pacific.

Given the ever-increasing carbon emissions and consumption of virgin materials, increasing trade in secondary materials is more of a necessity than a choice.

Transition to circular economy also poses opportunities for trade in services pertaining to waste management such as recycling, reconditioning, remanufacturing, reuse, and repair; sharing economy based on product as a service model (e.g., car rental solutions); traceability; and data transparency, among others.

Opportune time for developing countries to deepen participation in Global Value Chains

As the need for resources in developing countries continues to grow, participation in circular value chains[81] may help in ensuring steady flow of resources.

Many developing countries already have large recycling base for commodities like metals, apparels, plastics etc. which however are mostly informal in nature[82]. Swift formalisation of the recycling ecosystem in the lesser developed and developing countries would not only help in catering to the domestic needs but also enable them to emerge as significant exporters of secondary raw materials.

Countries exporting only virgin commodities from extractive sectors are losing out as the sale of scrap metal, even if not processed, has higher margins of profitability than the sale of ores and their concentrates besides the environmental benefits[83]. Countries without a mining industry may also benefit by recycling the imported waste and reducing dependence on international market. With access to a larger supply of recovered goods, components and materials and a larger consumer base, companies may be able to decrease costs through economies of scale. Development of the recycling industry would also create new sources of employment and ensure greater welfare for people who currently informally participate in this industry. It also incentivises enhancement of technological, human, and institutional capacities.

It may be noted that given the inordinate reliance on primary resources globally, flow of secondary raw materials alone cannot cater to the demand of industries. Thus, in the years to come, circular economy related trade will act as a complement to conventional resource-based trade. In fact, adopting circular economy practices in the leading export sectors of developing countries will help in generating comparative advantages and securing a larger share in global value chains of products that are relatively greener.

Furthermore, in a globalised world, adoption of circular strategies in more advanced nations also affects the domestic industry of countries like India. For example, adoption of circular strategies in the apparel Industry in the EU such as introduction of mandatory Ecodesign requirements pertaining to textile composition, chemicals content, quality of zippers, seams etc. may negatively impact India's apparel exports to the region if India fails to comply. Thus, the developing countries need to proactively track the changing regulations and identify the opportunities brimming in circular-economy related trade and strive to deepen their participation in such GVCs.

Measuring Circular Economy related Trade

During 2002 and 2019, on average, international trade in industrial waste has grown at 8.8%, faster than the total trade (7%). The European Union (EU) and North America are the world's main waste

[81] A circular supply chain involves a company reusing or repurposing waste and customer returns to convert those into new or refurbished products. A circular supply chain aims to minimize the use of raw materials and minimize discarded waste materials.

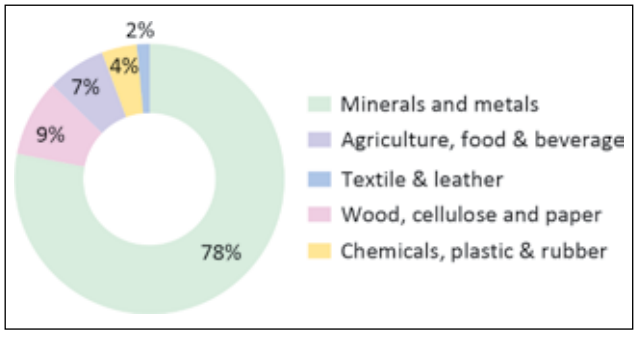
[82] Gridlines, World Bank Group. (2008). The informal recycling sector in developing countries: organizing waste pickers to enhance their impact.

[83] UNIDO. (2021). The Circular Economy: From waste to resource through international trade.

exporters while the EU and Asia are the biggest importers.

Furthermore, minerals and metals constitute 78% of globally traded waste, followed by wood, cellulose, and paper (9%); agriculture, food and beverages (7%); chemicals, plastics and rubber (4%); and textiles and leather (2%). Global trade in all types of waste exhibited positive growth from 2002 to 2019.

Figure 7: Average share of world industrial waste exports (2002–2019)



Source: UNIDO

It may be noted that the current Harmonised System does not adequately capture the trade flows associated with circular economy. It does not differentiate between the various types of goods in the circular economy[84].

- Firstly, not all types of wastes are classified.
- Secondly, it does not distinguish among waste that has already been converted into secondary raw material in the country of origin, waste that has not been treated prior to export and that can be valorized at destination and waste that cannot be valorised.
- Thirdly, the production process cannot be gauged by studying the trade flows[85]. For example, under the current HS classification, no distinction is made between products of metals made from virgin raw material and those made from recycled materials.

Notwithstanding the limitations, it is worthwhile to study the aspects of circularity in the sectors identified in the previous chapter namely, textiles and apparels, automobiles, and electronics.

1. Textiles and Apparels

Circularity in India's Textiles and Apparels Sector

India is one of the largest mechanical recycling hubs globally with over 900 recycling units. India's textile waste, estimated at about 7793 tonnes tonnes, represents 8.5% of global textile waste. The waste in the sector majorly arises from the following streams[86]-

- Pre-consumer waste: This is generated before the finished products reach the consumers and includes waste types such as spinning waste, fabric trimmings/cuttings, fabric deadstock, and unsold garment inventory. Waste from spinning comprises the largest share in pre-consumer waste. As about 75% of yarn production in India is cotton and cotton blends, cotton spinning waste constitutes the maximum share in total spinning waste in India. Other waste components include fabric deadstock, cutting waste generated from production of RMGs and unsold inventory arising due to extra fabric orders, rejected fabric rolls, manufacturing defects, or order cancellation. This type of waste has loss of high economic value.
- Domestic post-consumer textile waste: This includes garments or textiles discarded by domestic consumers. It consists of both reusables such as used clothes and linens that are still in good condition as well as non-reusable components such as clothes that are heavily soiled or have significant wear and tear and waste generated from commercial setups, including fabric cuttings from tailors. Domestic post-consumer waste has the highest contribution to total waste generated in the country.

[84] Ibid.

[85] Chatham House. (2022). Trade for an inclusive circular economy

[86] Fashion for Good. (2021). Wealth in Waste- India's Potential to Bring Textile Wate Back into the Supply Chain.

- Imported waste: Imported textile waste comprising of second-hand clothing and mutilated rags forms 7% of total textile waste in India.

The treatment of waste in the textiles and apparels sector could be through recycling, reuse, downcycling, and incineration. In India, about 59% of the total waste accumulated is recycled and reused albeit most of it involves low-grade recycling. The remaining 41% is downcycled for use in other industries or is incinerated or sent to landfills[87].

Exihibit 24: End Use of Apparel and Textile Waste

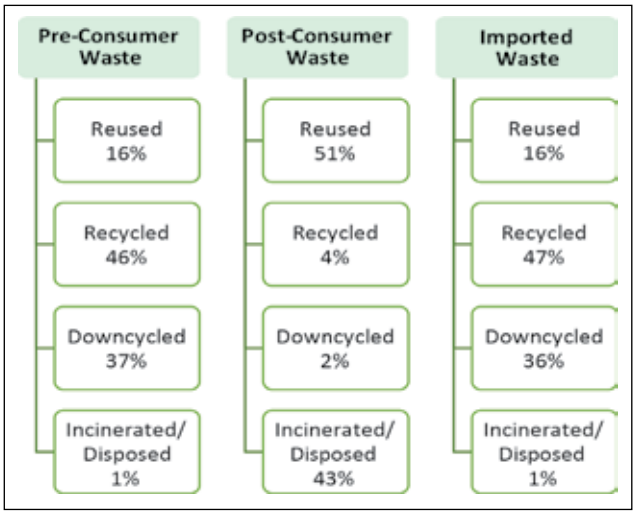
Reuse
Repair/Reconditioning
High Grade Recycling (Yarns closer to virgin quality)
Low Grade Recycling (Lower quality)
Downcycle
Incineration for Energy
Disposal

Source: Fashion for Good (2021)

Furthermore, different types of waste are treated differently. In the case of pre-consumer waste, while mill and surplus waste is mostly reused, cutting waste finds application in several industries. As regards domestic post-consumer waste, more than half of second-hand clothing is reused in domestic market whereas a sizable chunk is incinerated for energy or landfilled. Only a small part of the waste is recycled or downcycled. Of the imported waste, about 47% gets recycled, about 36% gets downcycled and only about 16% is re-exported after processing to countries in Africa and Asia.

The major recycling clusters in India are in Panipat and Tirupur. Besides, medium and small-scale recycling facilities are present in Amroha and parts of Rajasthan, Madhya Pradesh, Punjab and Gujarat. They are also the recycling hubs for imported second-hand clothing. Overall, about 59% of the waste in textile and apparels sector is reused or recycled. However, the proportion of waste entering global supply chains is low. This is because there is prevalence of low-grade recycling processes leading to quality issues.

Exihibit 25: End-use of textile waste in India



Source: Fashion for Good (2021)

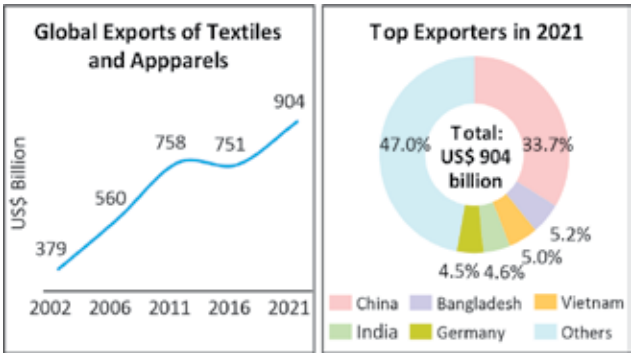
International Trade

World exports of textiles and apparels (HS 50-HS 63)[88] have grown by about 2.4 times during 2001 (US$ 379 billion) and 2021 (US$ 904 billion). China has remained the top exporter with a lion's share of 34% in global exports. The other top exporting countries in 2021 were Bangladesh (US$ 46.9 billion), Vietnam (US$ 44.9 billion), India (US$ 41.5 billion), and Germany (US$ 41 billion).

[87] Downcycling refers to textile waste materials/ recycled materials being downgraded into lower qualities such that they cannot be retrieved or brought back to the loop more than once or twice (eg. textile waste used for making wipes or used as fillings for bedding, quilts etc. Recycling on the other hand refers to utilising textile waste materials to recycle into yarns of a quality closer to the virgin yarns.

[88] HS 50: Silk; HS 51: Wool, fine or coarse animal hair; horsehair yarn and woven fabric; HS 52: Cotton; HS 53: Other vegetable textile fibres; paper yarn and woven fabrics of paper yarn; HS 54: Man-made filaments; strip and the like of man-made textile materials; HS 55: Man-made staple fibres; HS 56: Wadding, felt and nonwovens; special yarns; twine, cordage, ropes and cables and articles thereof; Carpets and other textile floor coverings; HS 58: Special woven fabrics; tufted textile fabrics; lace; tapestries; trimmings; embroidery; Impregnated, coated, covered or laminated textile fabrics; textile articles of a kind suitable for industrial use; HS 60: Knitted or crocheted fabrics; HS 61: Articles of apparel and clothing accessories, knitted or crocheted; HS 62: Articles of apparel and clothing accessories, not knitted or crocheted; HS 63: Other made-up textile articles; sets; worn clothing and worn textile articles; rags

Figure 8: Global Exports of Textiles and Apparels



Source: ITC Trade Map; India Exim Bank Research

Historically, trade of second-hand clothing has played a vital role in meeting the clothing needs of people living in less developed economies. However, in the recent years, the growing emphasis on sustainable and ethical fashion has put the spotlight on greater use of second-hand clothing in developed countries as well. For instance, in the US, in 2019, the online market for second-hand clothing expanded 21 times faster than conventional apparel markets[89]. However, the changing consumption trends have hitherto had limited implications on international trade.

It may be noted that under HS classification, used clothing waste is categorised under two headings- 6309 and 6310. HS 6309 encompasses worn clothing while HS 6310 mainly includes mutilated rags. However, used clothing with signs of mutilation and wear and tear also fall under HS 6310; hence clear demarcation between the two categories may not always be possible. In addition, the HS classification also categorises waste arising out of manufacturing processes such as spinning, and fabric trimmings/ cuttings based on the type of textile. The study analyses trade trends of cotton waste (HS 5202); man-made fibre waste (HS 5505); flax waste (HS 530130); and silk waste (HS 5003).

Exports of worn or second-hand clothing constituted a paltry share of 1% in world exports of apparels in 2021. During 2012 and 2021, exports in worn clothing witnessed a modest growth. From US$ 4.1 billion in 2012, exports of worn clothing increased to US$ 5.2 billion in 2021, an AAGR of 4%. Notably, after a 11% decline in 2020, the exports witnessed a sharp rise of 29% in 2021. The exports of mutilated rags have reduced from US$ 741.4 million in 2012 to US$ 618.1 million in 2021.

Figure 9: World Exports of Worn Clothing[90]

Source: ITC Trade Map; India Exim Bank Research

Figure 10: World Exports of Mutilated Rags[91]

Source: ITC Trade Map; India Exim Bank Research

China, being the largest exporter of apparels is also the top exporter of worn clothing (US$ 852.6 million), followed by the US (US$ 831 million), the UK (US$ 398 million), South Korea (US$ 347 million), and Germany (US$ 344 million).

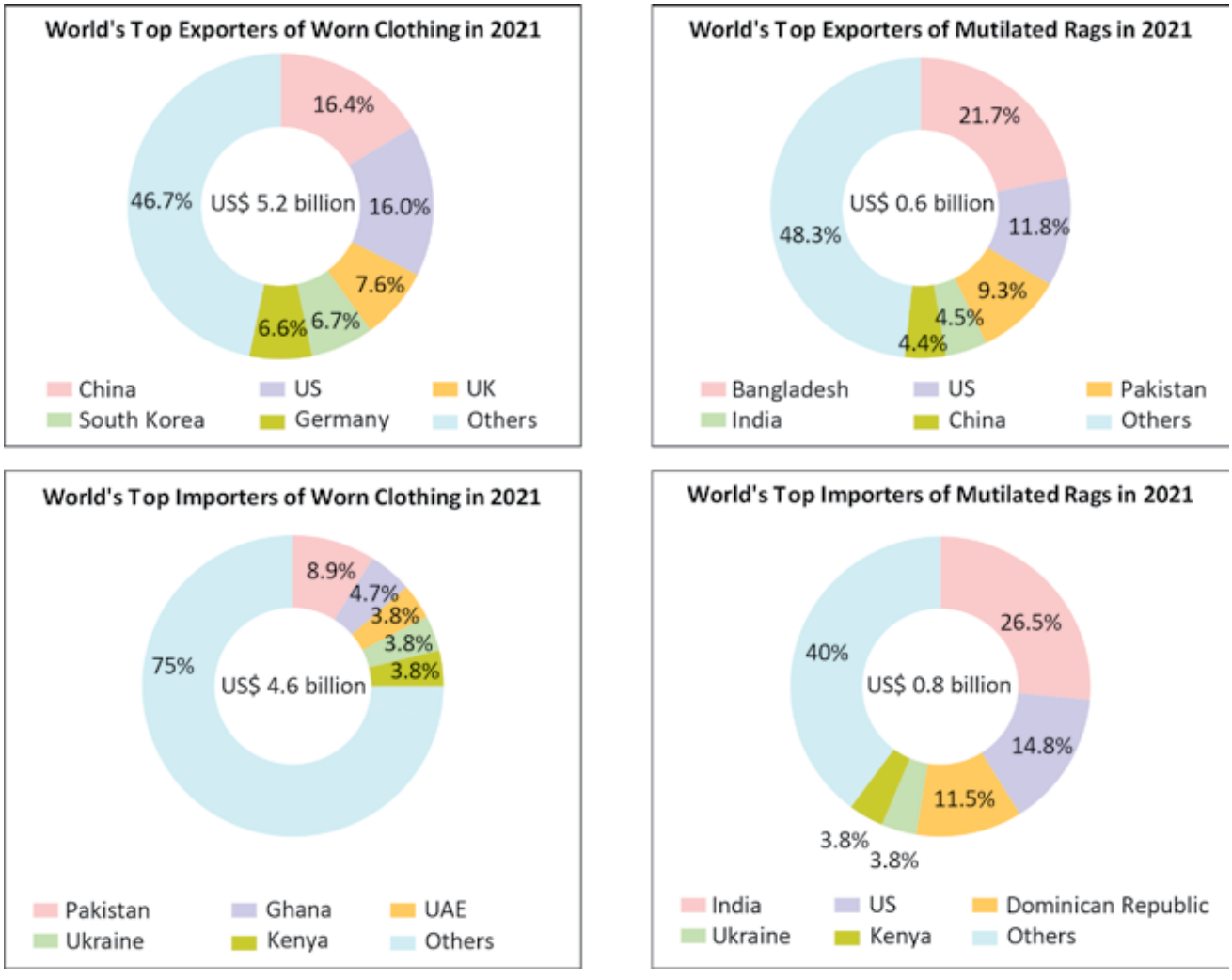
As regards exports of mutilated rags, Bangladesh is the top exporter (US$ 134 million), followed by the US (US$ 73 million), Pakistan (US$ 58 million), India (US$ 28 million), and China (US$ 27 million).

[89] Forbes. (2021). The Second-hand Market Is Growing Rapidly, Can Challengers Like Vinokilo Thrive And Scale?

[90] HS 630900: Worn clothing and clothing accessories, blankets and travelling rugs, household linen and articles for interior furnishing, of all types of textile materials, incl. all types of footwear and headgear, showing signs of appreciable wear and presented in bulk or in bales, sacks or similar packings (excluding carpets, other floor coverings and tapestries)

[91] HS 6310: Used or new rags, scrap twine, cordage, rope and cables and worn-out articles of twine, cordage, rope or cables, of textile materials

Figure 11: Top Trading Partners in Global Worn Clothing Trade



Source: ITC Trade Map; India Exim Bank Research

Coming to imports, the top importers of worn clothing in 2021 were Pakistan (U$ 402.7 million), Ghana (US$ 212.1 million), UAE (174,7 million), Ukraine (US$ 174.2 million), and Kenya (US$ 172.7 million). Notably, Pakistan's imports of worn clothing have nearly doubled from US$ 204.6 million in 2020 to US$ 402.7 million in 2021 on the back of rising inflation and poverty[92]. With respect to mutilated rags, India was the biggest importer (US$ 224.2 million), followed by the US (US$ 125 million), Dominican Republic (US$ 97.3 million), Poland (US$ 37 million), and Spain (US$ 28.5 million).

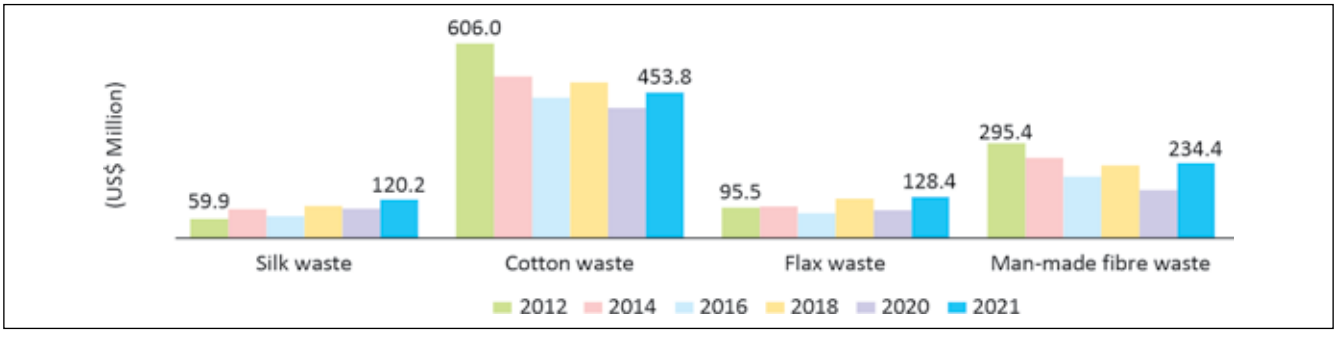
Used clothing is becoming an important source of apparel in low-and middle-income countries, much of which is recycled from wealthier nations. For example, Africa has one of the largest used clothing markets in the world. It is estimated that about 80% of the Africans buy second-hand clothes imported from countries like the US, Europe, India, and Pakistan[93]. Furthermore, not just in less developed nations, the market for second hand clothing is booming in high-income nations as well as it is seen as a low-cost source of sustainable fashion. For example, in the US, the second-hand clothing market is projected to more than triple from US$28 billion in 2019 to US$ 80 billion in 2029[94].

[92] Arab News. (2021). Imports of used clothes nearly double in Pakistan as inflation and poverty soar

[93] Common Objective. (2018). Trade in Second-hand Clothing – Scale and Impact

[94] ThredUP. 2021 Resale Report.

Figure 12: International Exports of Textile Waste



Source: ITC Trade Map; India Exim Bank Research

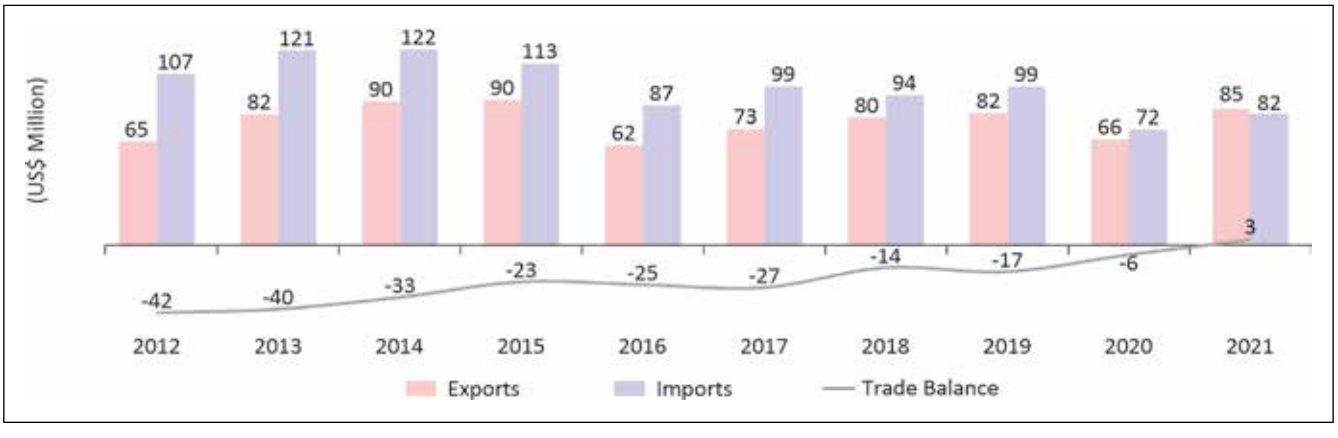
Coming to waste arising out of manufacturing processes, it is observed that globally, exports of cotton waste (HS 5202) were the highest among all categories of wastes, at US$ 453.8 million in 2021. However, the exports have seen a notable decline from US$ 606 million in 2012. Similarly, exports of waste of man-made fibre (HS 5505) have dipped from US$ 295.4 million to US$ 234.4 million during 2012-2021. Exports of flax waste (HS 530130) have witnessed a growth, rising to US$ 128.4 million in 2021 and exports of silk waste (HS 5003) have more than doubled from US$ 59.9 million in 2012 to US$ 120.2 million in 2021. The declining export values of textile wastes point at the missed opportunities in valorisation of textile waste.

India

The value chain for worn clothing and textiles has existed for decades. However, the trade is still at a rudimentary stage with the presence of only a few established players in the market. India's exports of worn clothing constituted a share of 0.6% in its total apparel exports in 2021. From US$ 65 million in 2012, the exports have grown to US$ 85 million, registering a moderate AAGR of 5%.

Coming to imports, notably, back in 2012, India's imports of second-hand clothing, at US$ 107 million constituted a share of 25% in India's total imports of apparels. With imports recorded at US$ 82 million in 2021, the share has gone down to 6.6%. During 2012 and 2021, the imports of second-hand clothing have contracted by 2%, on average. India's top exports destinations for worn clothing are UAE and African and South-East Asian countries. As regards imports, about 63% of imported worn clothing in 2021 was from the US, followed by Canada (15%) and Japan (6%).

Figure 13: India's Foreign Trade in Worn Clothing

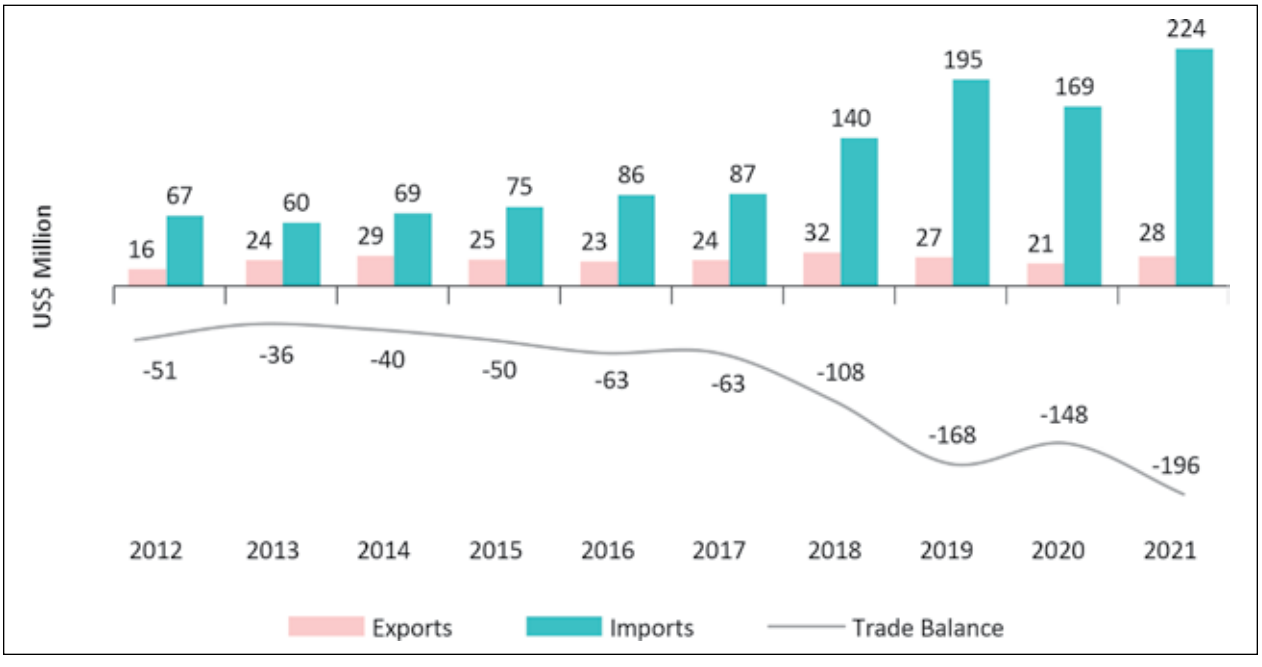


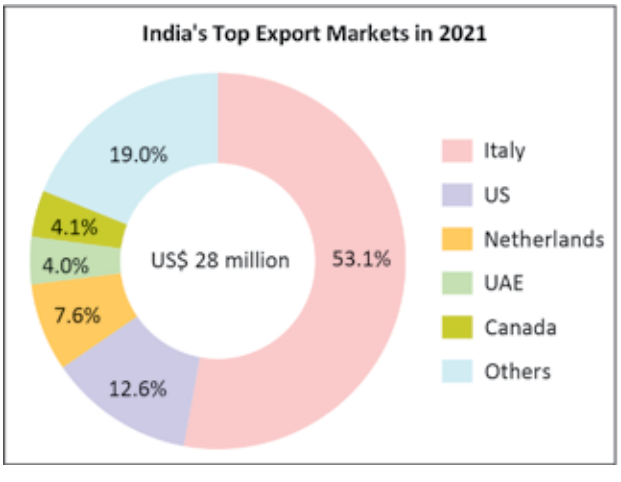
Source: ITC Trade Map; India Exim Bank Research

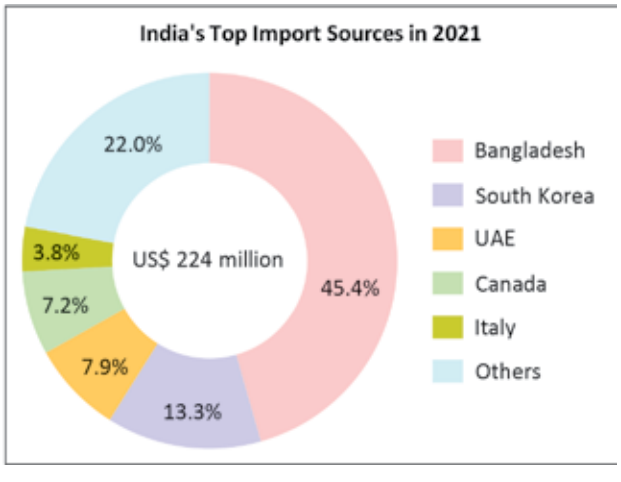
India's trade in mutilated rags has witnessed a considerable increase. India is the fourth largest exporter of mutilated rags, globally with a share of 4.5% in global exports. The top three exporters in 2021 were Bangladesh (21.7%), the US (11.8%), and Pakistan (9.3%). Exports during 2012 and 2021 rose at an AAGR of 9%, reaching US$ 28 million in 2021. India is the largest importer of mutilated rags in the world with a share of 27% in global imports. During 2012 and 2021, imports of mutilated rags registered an AAGR of 17%, rising from US$ 67 million to US$ 224 million. More than half of India' exports of mutilated rags went to Italy and the majority of the imports were from Bangladesh.

India is a net exporter of silk and cotton waste whereas a net importer of flax and man-made fibre waste. In 2021, India was largest exporter of cotton waste, the third largest exporter of silk waste, and the sixth largest exporter of flax waste. During 2012-2021, exports of flax waste have registered the highest AAGR of 106%, followed by silk waste (17.2%), and cotton waste (16.6%). As regards imports, flax and cotton waste imports grew at an AAGR of 75% and 26%, respectively during the period.

Figure 14: India's Foreign Trade in Mutilated Rags

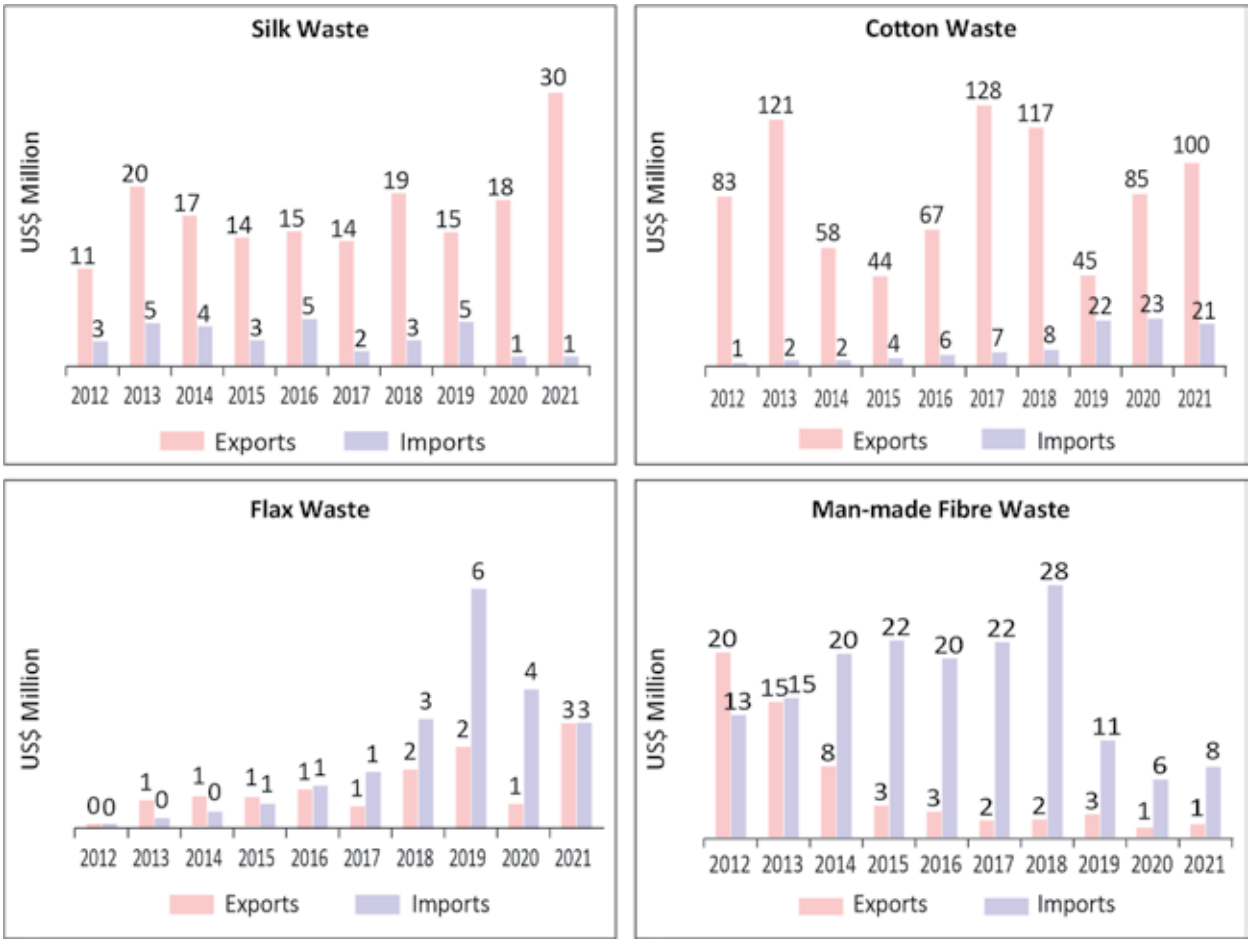






Source: ITC Trade Map; India Exim Bank Research

Figure 15: India's Foreign Trade in Textile Waste



Source: ITC Trade Map; India Exim Bank Research

Trade Policy

Imports of second-hand clothing and mutilated rags fall under the restricted category in India's import policy. The imports are only allowed via the Mundra port. From the port, the imports are directly transferred to the importers located at Kandla Special Economic Zone for processing, for sorting, reexport, and recycling processes. It may be noted that while the import of second-hand clothing requires a licence from the government, certain categories of mutilated rags such as cotton rags (HS 63101020), woollen rags-others (HS 63109010), and synthetic rags (HS 63109040) are exempted from license requirements.

The imports meant for domestic use go through a few stakeholders before reaching the final consumer. The imports of mutilated rags are segregated for the wipes and recycling industry. Good-quality wipes are exported as well for industrial cleaning purposes. The leftover waste is sent for downcycling into fibre for filling purpose. The duties on imports are also high. The basic customs duty on imports of worn-clothing and mutilated rags is 25%

It is observed that despite restrictions, India has high import demand particularly for mutilated rags. One of the reasons for the high demand could be India's significant role as a provider of blankets made from the mutilated rags across South Asia and Africa for charity purposes The mushrooming recycling industry is however largely informal. To capitalise on the growing attention towards sustainable clothing and minimising textile waste, India should place

itself as the leading recycling hub and exporter of secondary textiles and apparels. This may be aided by a transparent regulatory system that incentivises circular trade.

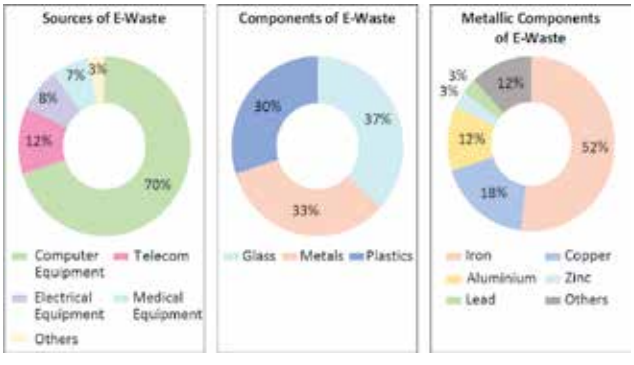
2. Electronics

Circularity in India's Electronics Sector

E-waste encompasses a host of electronic items, such as personal computers, televisions, mobile phones, and printers, as well as electrical goods like refrigerators and air-conditioning units which are no longer fit for their originally intended use and ready to be discarded.

E-waste may be classified as hazardous or non-hazardous under the Basel Convention depending on its composition. For example, CRT (cathode-ray tube) monitors are considered hazardous as they may contain up to 2 kg of lead, a poisonous metal. E-waste may also contain precious metals such as gold, copper, and nickel along with rare earth elements. E-waste is thus a highly valuable resource for recovering precious and heavy metals for use as secondary raw materials.

Figure 16: E-Waste in India



Source: Sattva Consulting (2022); Centre for Science and Environment (2020)

India generates more than three million tonnes of e-waste annually, and also imports e-waste from other countries[95]. Around 70% of e-waste in India comprises of computer equipment. Telecom is the second largest source of e-waste (12%) largely attributed to the digital revolution that country is undergoing[96]. Further, the three main components of e-waste are glass, metals, and plastics. Within metals, iron is a key constituent along with copper, aluminium, zinc, and lead, among others[97].

In India, the contribution of individual consumers towards e-waste disposal in the informal sector is considerably high. Manufacturers of electrical and electronic components and assemblers are also a major source of e-waste generation in India[98].

E-waste recycling is done in two stages - manual collection, sorting, separating, and dismantling followed by mechanical processing which involves shredding, grinding, etc. Recovered materials are then sent to relevant facilities for further treatment.

More than 90% of India's e-waste is processed by the informal sector consisting of waste pickers[99]. They collect, dismantle, and recycle the waste outside the regulated system, often adopting non-scientific and dangerous methods. Since the extraction processes may not be very efficient, informal recycling doesn't lead to optimum extraction of precious resources from the e-waste and poses serious health risks for the workers.

Although e-waste management legislation is in place in India since 2011[100], the waste management industry lags in terms of formalisation.

As of April 2022, there were a total of 472 dismantlers/recyclers authorised by the State Pollution Control Boards (PCBs)/ Pollution Control Committees (PCCs) under E-Waste (Management) Rules, 2016. These together have a recycling capacity of 14.3 lakh MTPA while the quantum of e-waste exceeds 3 million MTPA.

[95] Global E-Waste Monitor 2020 report.

[96] Sattva Consulting. (2022). E-Waste: From Toxic to Green.

[97] Biswas, A. and Singh, S.(2020). E-waste Management in India: Challenges and Agenda, Centre for Science and Environment,

[98] CSE.2020. E-Waste Management In India: Challenges And Agenda

[99] CSE.2020. E-Waste Management In India: Challenges And Agenda

[100] E-waste Management and Handling Rules, 2011 subsequently amended in 2016 and 2018.

Moreover, majority of formal recyclers currently operate much below their capacity, wherein they are not even processing half of the authorised quantum of waste and are storing it in hazardous conditions. India ranks the third in terms of generation of e-waste with the lowest e-waste collection rate among the top five ranked e-waste generating countries (Table 6).

Table 6: Top Five E-waste Generating Countries in 2019

Rank	Country and rank in e-waste generation	Electrical and electronic equipment (EEE) placed on the market (kg/capita)	E-waste generation (kg/capita)	E-waste collection rate (%)
1	China	13.3	7.2	16
2	USA	25.3	21	15
3	India	5.8	2.4	1
4	Japan	21.3	20.4	22
5	Germany	18.2	19.4	52

Source: CSE. (2020)

International Trade

Electronics industry is among the largest global industries and continues to witness exponential growth. The world exports of electronic devices (HS 85)[101] have quadrupled during 2002 to 2021, from US$ 893.9 billion to US$ 3394 billion. China has emerged as the formidable leader in exports of electronics having a global share of 26%. Hong Kong and Taiwan follow with a share of 12% and 6% in global electronics exports, respectively.

In 2021, India's export of electronics stood at US$ 19 billion while imports were valued at US$ 57 billion. India remains a net importer of electronics, running the third largest trade deficit of US$ 38 billion in the sector in 2021.

Figure 17: Global Exports of Electronics

Source: ITC Trade Map; India Exim Bank Research

During 2012 and 2021, India's exports and imports of electronics have grown at similar AAGR of 8.2% and 8.4%, respectively. India's export markets for electronics are diversified with the US being the top export destination with a share of 18% in India's electronic exports to the world. Import sources on the other hand are quite concentrated with China accounting for almost half of India's electronic imports.

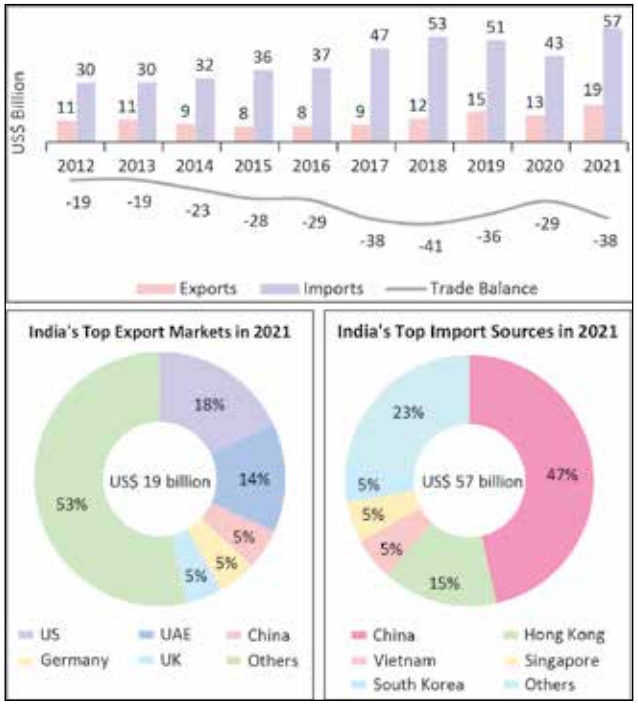
In global supply chains, e-waste often originates in developed regions such as Europe, the United States, and Japan. Instead of dispatching to recycling facilities, the waste in these countries is often transported to developing countries to avoid the strict domestic regulations pertaining to recycling and save costs. For example, it costs about US$ 18 to safely remove lead from a CRT monitor in the US. Illegally disposing the CRTs and other such e-waste leads to savings of between 200% and 400% of the cost of formal recycling[102]. The diversion of waste has resulted in underutilisation of recycling facilities in these countries. For example, Australia reportedly recycles only around 5% of e-waste collected, but exports around 60% of used computers[103]. Trade is also driven by the demand for second-hand goods in developing countries.

[101] HS 85: Electrical machinery and equipment and parts thereof; sound recorders and reproducers, television image and sound recorders and reproducers, and parts and accessories of such articles

[102] UNEP. (2013). Transnational Organized Crime in East Asia and the Pacific

[103] UNODC. Illicit trade in e-waste from the world to the region

Figure 18: India's Foreign Trade in Electronics



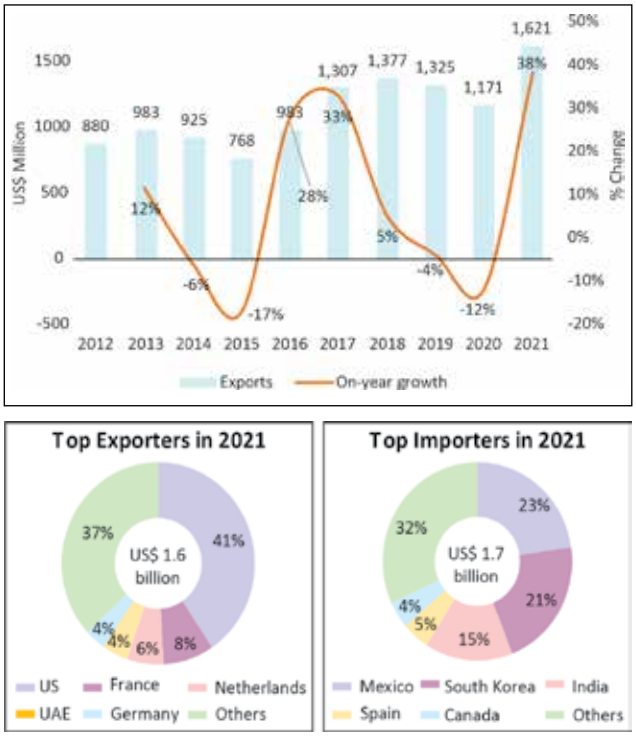
Source: ITC Trade Map; India Exim Bank Research

It may be noted that the current global HS codes do not distinguish between new and used electronics. Further, there is lack of differentiation between e-waste, used electronics and secondary materials extracted from e-waste in the context of international trade flows. Due to the growing importance of waste as a resource and to monitor the international flows of these goods, the HS 2022 edition will include new specific codes for electronic scrap and waste suitable only for disposal or recovery operations under a new heading 85.49.

Nevertheless, trade in e-waste can be gauged partly by studying the flows of waste and scrap of primary cells, batteries, and accumulators[104]. In 2021, the world exports of waste and scrap of cells, batteries and accumulators stood at US$ 1.6 billion, up from US$ 880 million in 2012. The exports grew at an AAGR of 8.7% during the period.

The United States was the major exporter in 2021 with a share of 41% in global exports of waste and scrap of primary cells, batteries and accumulators followed by France (8%), the Netherlands (6%), the UAE (4%), and Germany (4%). The top importers were Mexico with an import share of 23%, South Korea (21%), India (15%), Spain (5%), and Canada (4%).

Figure 19: World Exports of Waste and Scrap of Primary Cells, Batteries and Accumulators



Source: ITC Trade Map; India Exim Bank Research

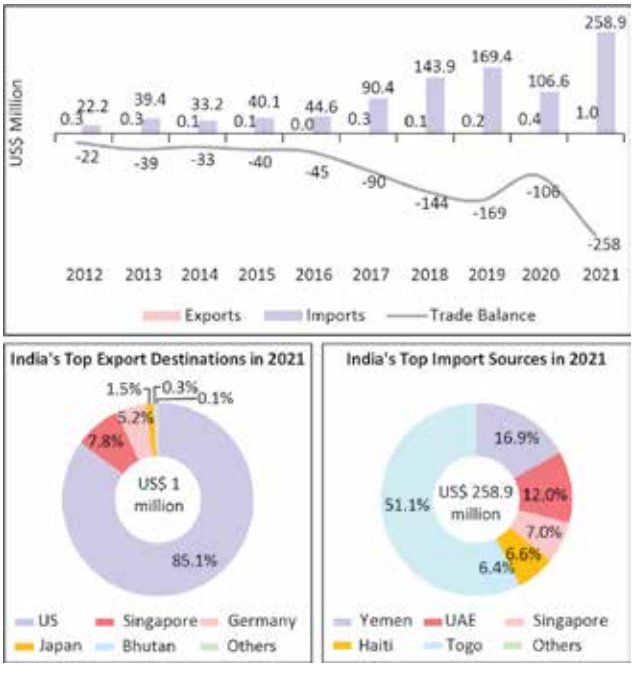
India's trade in waste and scrap of cells, batteries and accumulators has seen a remarkable rise during the last decade. Exports have increased at an AAGR of 114%, from US$ 0.3 million to US$ 1 million. The imports have grown at an AAGR of 42%, from US$ 22 million to US$ 259 million. Consequently, India's trade deficit has seen a rise from US$ 22 million to US$ 258 million during the period.

It may be noted that while the exports are highly concentrated with about 85% of the waste supplied to the US, imports are highly diversified. The top import sources for the waste in 2021 were Yemen (16.9%), the UAE (12%), Singapore (7%), Haiti (6.6%), and Togo (6.4%).

[104] HS 854810: Waste and scrap of primary cells, primary batteries and electric accumulators; spent primary cells, spent primary batteries and spent electric accumulators

It is evident from the above trends that demand for e-waste in India is increasing. However, it is not being processed in efficient ways due to high informal nature of the sector.

Figure 20: India's Foreign Trade in Waste and Scrap of Primary Cells, Batteries and Accumulators



Source: ITC Trade Map; India Exim Bank Research

Trade Policy

Imports of e-waste into India are banned under the Hazardous and Other Wastes (Management and Transboundary Movement) Rules, 2016, except for refurbishment and re-exportation of second-hand goods. However, due to the difficulties faced in differentiating between the two and the challenges faced in monitoring at the ports, imports of e-waste are prevalent. As per Schedule III of the Rules, several types of hazardous waste may be imported with prior informed consent. Besides, a select products are allowed to be traded without seeking permission as well.

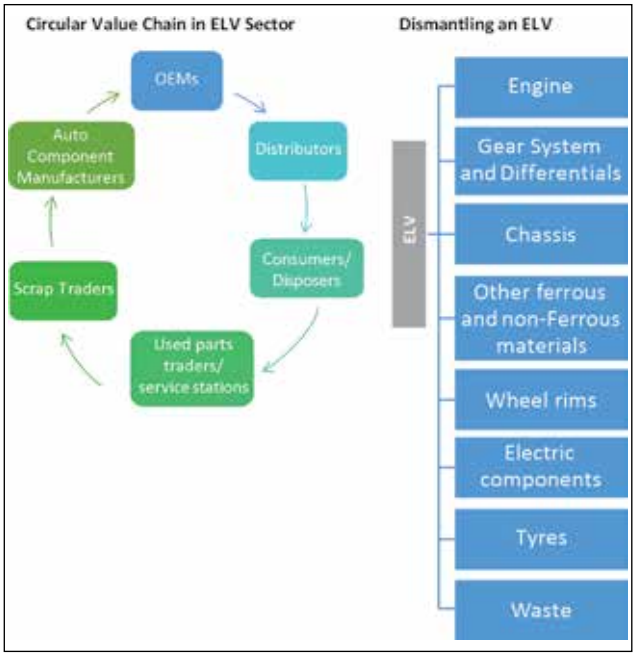
E-waste is a valuable resource whose full potential is not being realised currently. With robust processing standards, regulated trade of e-waste and investments in relevant technology, India can establish sustainable value chains in the sector and become a global supplier of secondary materials extracted out of the waste.

3. Automobiles

Circularity in Automobiles Sector in India

The automobile sector in India has witnessed phenomenal expansion in the last two decades in terms of both demand for automobiles and manufacturing. Given the rising consumption, it is estimated that India will have about 22 million End of Life Vehicles (ELVs)[105] by 2025[106]. The automobile recycling ecosystem in India, however,

Exhibit 26: Circular Value Chain in ELV Sector



Source: CPCB and GIZ (2015)

[105] According to European Environmental Agency , end-of life vehicle (ELV) means a vehicle which is waste whereby waste means any substance or object which the holder disposes of or is required to dispose of pursuant to the provisions of national law in force.
In the Indian context, ELVs refers to all vehicles which are no longer validly registered; or declared unfit through Automated Fitness Centers or their registrations have been cancelled; or are self-declared by the legitimate registered owner as a waste vehicle due to any circumstances that may arise from fire, damage, natural disaster, riots or accident etc., or any other reason at the discretion of the owner.

[106] Business Standard. (2021). Building for scrap: Does India have the capacity to handle this?

is largely informal and unorganised. While these clusters have an established ecosystem for sourcing, dismantling, and selling of spare parts and scrap, the methods used are unscientific with use of rudimentary hand tools. These processes lead to leakage of toxic constituents into the environment and do not ensure optimum recovery rate of the materials. There are informal recycling clusters in several parts of the country such as Mayapuri in Delhi, Pudupet in Chennai, Ukkadam in Coimbatore, and Lohar Chawl in Mumbai, among others.

Ferrous and non-ferrous metals comprise about 75% of the vehicles while the rest are materials like plastics, rubber, glass, textiles etc. At the processing centres, the various parts are reused or recycled as per their condition. Trade of parts like engines is highly lucrative and the engines are also informally exported to neighbouring countries such as Bangladesh.

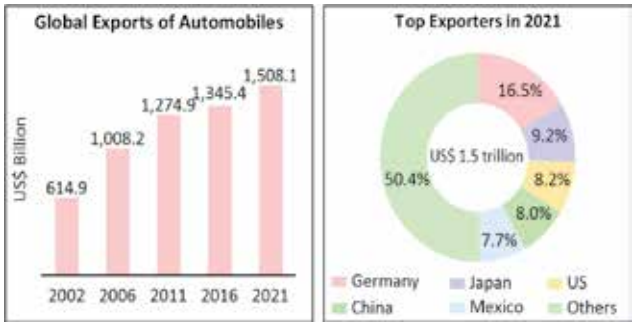
Interestingly engines also find other uses, for example, as generators or to draw ground water in rural areas. Gear systems and differentials, after being broken down are sold as used spares. Chassis have a very low obsolescence rate, known to last as long as 50 years. However, with new designs, demand for chassis has gone down. The business of reselling wheel rims is also quite lucrative and expanding rapidly. Further, electric components are sold as scrap for extraction of metals. Used tyres of vehicles find multiple uses including as spares in running vehicles and as a source of rubber and fuel. Lastly, materials like broken glass, seat covers and foam, and rubber piping are dumped as ELV waste, often irresponsibly.

With the launch of the Vehicle Scrappage Policy in 2021, formal recycling in India is set to witness a boost. The country's first automated and organised vehicle scrapping and recycling facility, built by Maruti Suzuki Toyotsu India Pvt Ltd. has begun operations in Greater Noida. Several such facilities are in the pipeline.

International Trade

The world exports of automobiles (HS 87)[107] have risen from US$ 614 billion in 2002 to US$ 1.5 trillion in 2021, registering an AAGR of 6% during the period. Germany is the leading exporter of automobiles with a share of 16.5% in 2021, followed by Japan (9.2%), the USA (8.2%), China (8%), and Mexico (7.7%).

Figure 21: World Exports of Automobiles



Source: ITC Trade Map; India Exim Bank Research

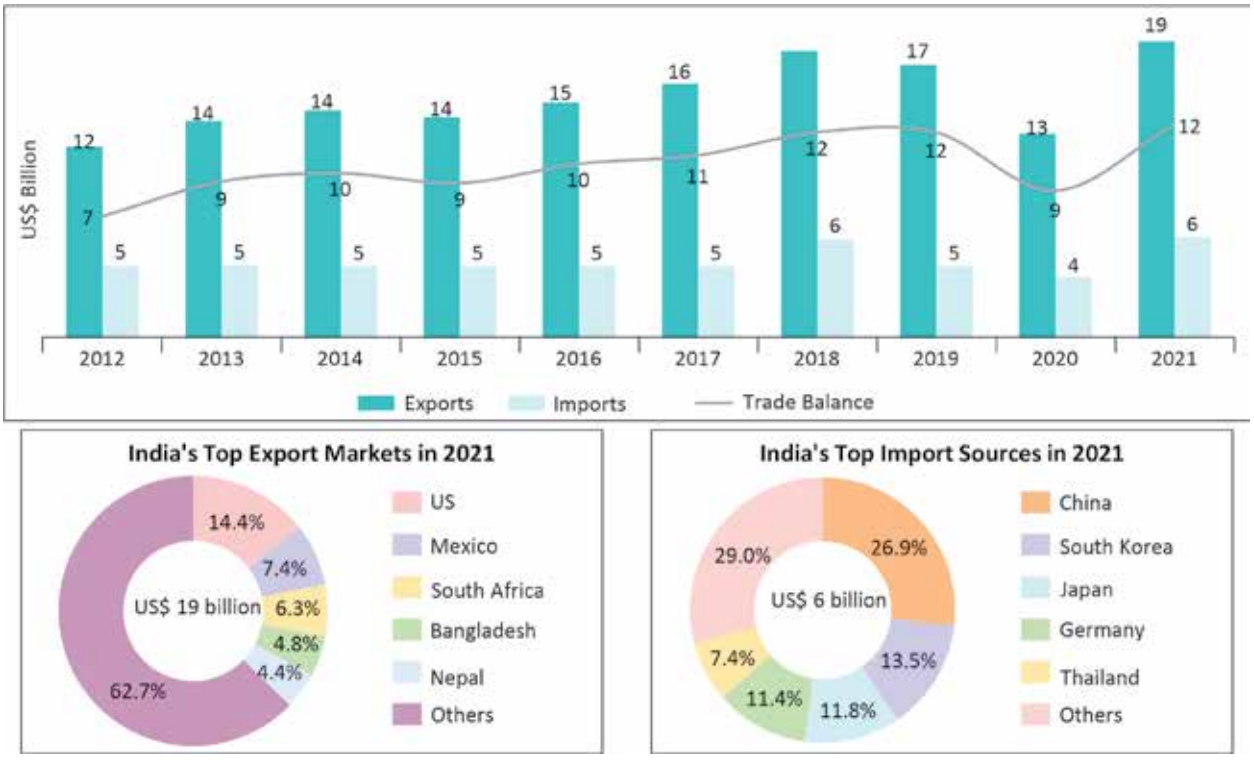
India's Trade in Automobiles

India is a net exporter of automobiles with exports recorded at US$ 19 billion in 2021. During 2012 and 2021, exports have grown at an AAGR of 6%. Imports have grown at slower rate, rising from US$ 5 billion in 2012 to US$ 6 billion in 2021.

As is the case of electronics, the current HS classification does not distinguish between new and used vehicles. Besides, secondary materials and ELVs have also not been classified. This makes it difficult to ascertain the level of circularity in present international trade flows. Nevertheless, the following section discusses trade in used vehicles and parts based on existing literature and by studying the trade flows of select auto parts.

[107] HS 87: Vehicles other than railway or tramway rolling stock, and parts and accessories thereof

Figure 22: India's Foreign Trade in Automobiles



Source: ITC Trade Map; India Exim Bank Research

Trade in Used Vehicles

Globally, the total number of used vehicles sold is estimated to be at least double that of new vehicles[108]. Trade in used vehicles may prove to be more energy efficient when there is a transfer of advanced technology, for example the import of used electric and hybrid electric vehicles by developing countries.

The main factors driving global trade of used vehicles are the high degree of affordability they offer, the need for frequent replacement of vehicles in developed countries due to stringent emission standards and the lax regulations in developing economies, which makes exporting more cost effective for developed car manufacturing countries.

Despite a flourishing market, there are currently no regional or global agreements on trade in used vehicles[109]. Developing countries, in general, either have banned the import of used vehicles which however is poorly enforced or have limited or no regulations on governing the quality and safety of imported used vehicles. Equally, most of the developed countries do not have restrictions on the export of used vehicles.

The largest exporters of used vehicles are the EU with a share of 54% in total exports, Japan (27%), and the USA (18%). They together exported 14 million used light duty vehicles (LDVs) globally during 2015 and 2018. EU's exports of used vehicles are mainly to West and North Africa, Japan's to Asia and East and Southern Africa, and the US to the Middle East and Central America.

About 90% of the import partners of these top exporters are developing and transition countries. During the period, Africa imported the largest number (40%) of used-vehicles followed by Eastern Europe (24%), Asia-Pacific (15%), the Middle East (12%), and Latin America (9%)[110].

[108] UNEP. 2020. Used vehicles and the environment.
[109] Ibid.
[110] Ibid.

The reliance of Africa on imports of used vehicles for meeting its mobility requirements is worth noting. More than 60% of vehicles added In Africa's fleet annually is through the imports of used vehicles. The share of imports in countries' fleet range from zero in South Africa which has imposed a ban on imports to 97% in Kenya. Similarly, many countries in Latin America, Central America, and the Caribbean are highly dependent on imports of used vehicles. In Asia and the Pacific, the share of used vehicle imports is lower, because countries like India, China, and several Southeast Asian countries have imposed a ban on imports. Nevertheless, imports of used vehicles are high in Pakistan, Sri Lanka, Bangladesh, Myanmar, and Cambodia, among others[111].

It may be noted that the demand for used cars is not constrained to only developing countries. In 2018, 55% of used LDVs sold by the EU were to countries within the region. Thus, a regulated ecosystem for trade in used low and no emissions cars would be beneficial for the trading countries as well as the environment.

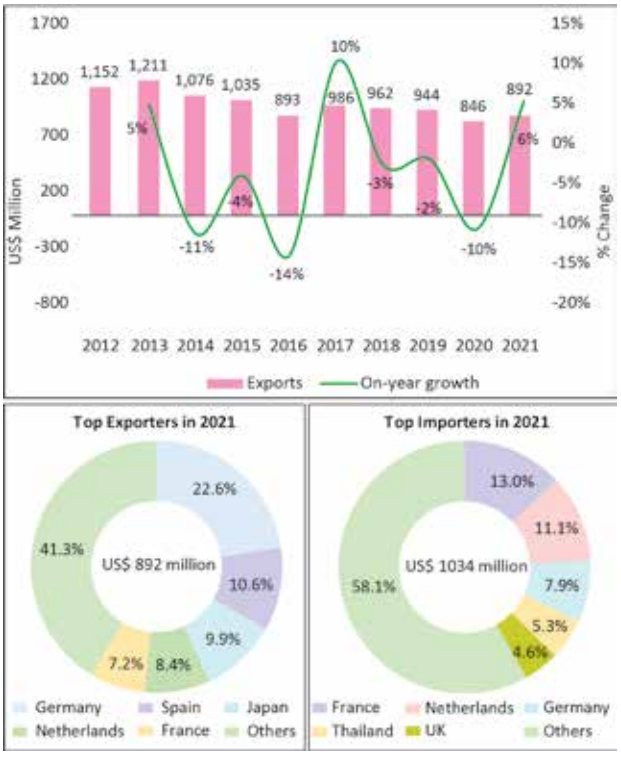
Trade in Retreaded or Used Tyres

Retreading is a process of renewing the tread and the sidewall rubber of the tyre to make it capable of reuse. Cost effectiveness of retreaded tyres in comparison to new tyres along with lesser contribution to emissions make these tyres a sustainable choice. An increasing number of manufacturers have started using retreaded tyres in their commercial and heavy vehicles fleet. Exports of retreaded or used tyres stood at US$ 1.2 billion in 2012. However, in 2021, the exports have fallen to US$ 892 million, registering a contraction of 0.7% during the period.

The top exporters of retreaded tyres in 2021 were Germany (23%), Spain (11%), and Japan (10%). The top importers, on the other hand were France (13%), the Netherlands (11%), and Germany (7.9%).

[111] Ibid.

Figure 23: World's Exports of Retreaded or Used Tyres[112]



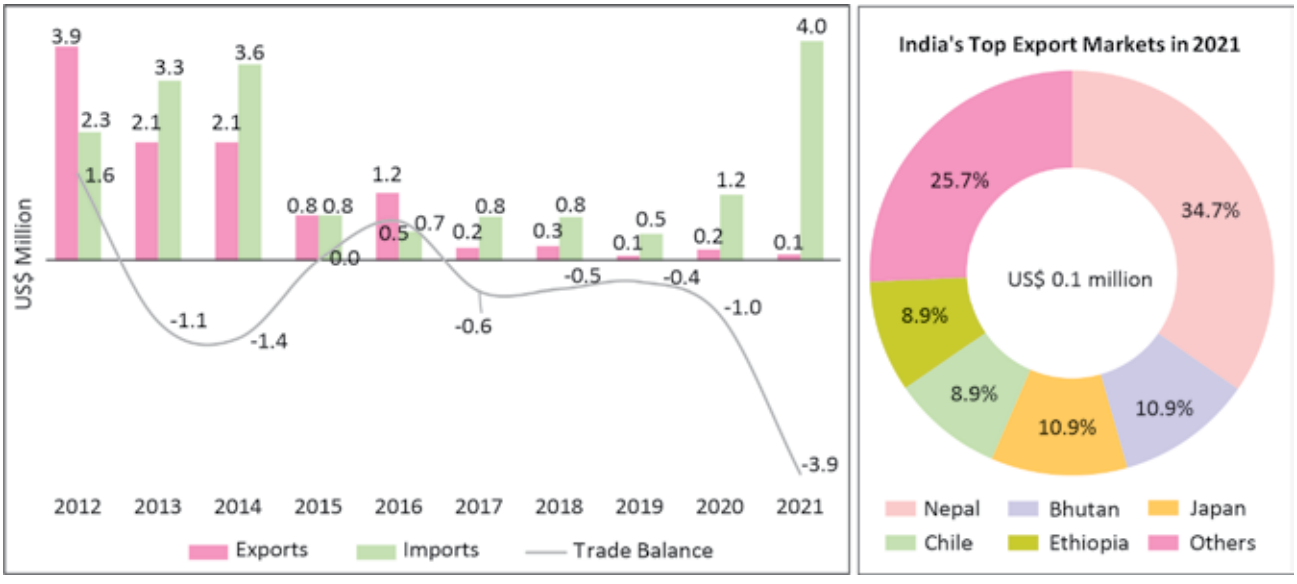
Source: ITC Trade Map; India Exim Bank Research

Despite having a large tyre retreading industry, India's exports of retreaded or used tyres constituted a paltry share of 0.01% in global exports. At US$ 0.1 million, the exports have contracted by an average of 10% during 2012 and 2021. Imports, on the other hand have increased from US$ 2.3 million in 2012 to US$ 4 million in 2021. Consequently, from a net exporter, India has become a net importer of retreaded or used tyres.

India's top export destinations for retreaded or used tyres are its neighbouring nations, Nepal (35%) and Bhutan (11%), followed by Japan (11%), Chile (9%), and Ethiopia (9%). The imports are extremely concentrated with UAE (probably reexported to African markets) being the only major import source with a share of 98.6% in total imports.

[112] HS 401210: Retreaded tyres of rubber; HS 401211: Retreaded pneumatic tyres, of rubber, of a kind used on motor cars including station wagons and racing cars; HS 401212: Retreaded pneumatic tyres, of rubber, of a kind used on buses or lorries; and HS 401220: Used pneumatic tyres of rubber.

Figure 24: India's Foreign Trade in Retreaded or Used Tyres



Source: ITC Trade Map; India Exim Bank Research

The global fleet of LDVs is set to at least double by 2050[113]. Instead of perceiving import of low and no emissions used vehicles as detrimental to domestic industry, their positive impact should be realised. Such vehicles provide the population of middle and low-income countries with affordable mobility options, access to advanced technologies, and also help avoid carbon emissions that would be otherwise generated in production of new vehicles. Harmonised regulations need to be developed for regulating the trade of used low-emission vehicles.

The trade flow analysis of used or retreaded tyres sheds light on the opportunities that are currently going unutilised for India in increasing its participation in global circular economy of automobiles. Formalizing and introducing capacity building measures in the hitherto vast, yet informal, automobile recycling industry in India would play an instrumental role in placing India as a leading player in circular economy related trade in automobiles.

Existing trade policy

In India, the second hand or used vehicles not older than three years from the date of manufacture can be imported provided that the vehicles comply with the mandated technical specifications. The vehicles imported should have a minimum roadworthiness for a period of 5 years from the date of importation into India with assurance for providing service facilities within the country during the five-year period. The import is allowed only through the customs port at Mumbai. The import duty for imports of used cars in India is 125%[114].

Trade in Metal Scrap

As noted above, ferrous and non-ferrous metals make up 75% of a vehicle. As ELVs in India continue to pile up, their adequate recycling would release huge quantum of secondary raw materials, thereby leading to a reduction in extraction and use of virgin materials. Recycling processes use much lesser energy than required for primary production. For example, copper recycling uses 85% less energy than required for primary production and avoids approximately 40 million tonnes of global CO_2 emissions as well as usage of huge quantities of water. Recycling also avoids accumulation of waste in landfills which results in contamination of soil and water sources.

[113] UNEP. 2020. Used vehicles and the environment.

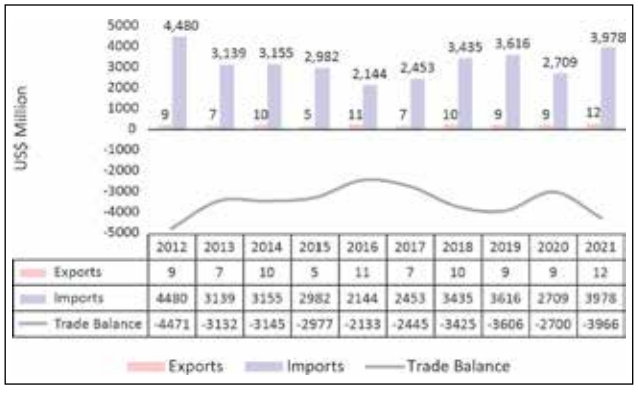
[114] SIAM

Looking at the international trade flows of metal scrap would help in ascertaining the international as well as domestic demand for secondary resources and in gauging where India currently stands globally in the transition to circular trade of metals.

Ferrous scrap

- India is the second largest importer of ferrous scrap (HS 7204)[115], globally after Turkey. India's exports of ferrous scrap are negligible vis-à-vis the world exports.
- At US$ 12 million, India's exports constituted a share of 0.02% in global exports of ferrous scrap in 2021. On the other hand, at US$ 4 billion, India's imports constituted a share of 7% in global imports of ferrous scrap.
- In Union Budget 2021-22, custom duty exemptions were given on import of steel scrap to provide relief to secondary steel producers. The exemption has been further extended by a year in this year's budget.

Figure 25: India's Trade in Ferrous Scrap



	2012	2013	2014	2015	2016	2017	2018	2019	2020	2021
Exports	9	7	10	5	11	7	10	9	9	12
Imports	4480	3139	3155	2982	2144	2453	3435	3616	2709	3978
Trade Balance	-4471	-3132	-3145	-2977	-2133	-2445	-3425	-3606	-2700	-3966

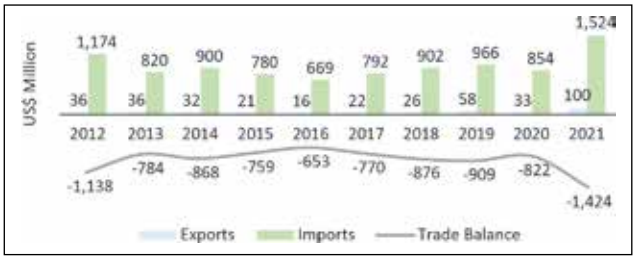
Source: ITC Trade Map; India Exim Bank Research

Copper Scrap:

- India is one of the major importers globally of copper scrap (HS 7404)[116] as well. Its share in global imports of copper scrap stood at 4% in 2021. The imports have grown from US$ 1.2 billion in 2012 to US$ 1.5 billion in 2021. Exports have also shown an increase, from US$ 36 million in 2012 to US$ 100 million in 2021.

In Union Budget 2021-22, duty on copper was slashed from 5% to 2.5% to boost recycling.

Figure 26: India's Trade in Copper Scrap

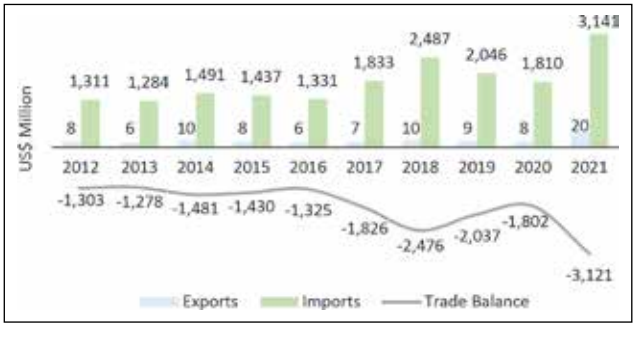


Source: ITC Trade Map; India Exim Bank Research

Aluminium scrap:

- India is the top importer of aluminium scrap (HS 7602)[117] in the world with a share of 15% in total imports. India's imports of aluminium scrap have seen a considerable rise-from US$ 1.2 billion in 2012 to US$ 3 billion in 2021.
- The trade deficit has also consequently risen to US$ 3.1 billion in 2021. The present import duty on aluminium scrap is 2.5%.

Figure 27: India's Trade in Aluminium Scrap



Source: ITC Trade Map; India Exim Bank Research

[115] HS 7204: Ferrous waste and scrap; remelting scrap ingots of iron or steel (excluding slag, scale, and other waste from the production of iron or steel; radioactive waste and scrap; fragments of pigs, blocks or other primary forms of pig iron or spiegeleisen)

[116] HS 7404: Waste and scrap, of copper (excluding ingots or other similar unwrought shapes, of remelted copper waste and scrap, ashes and residues containing copper, and waste and scrap of primary cells, primary batteries, and electric accumulators)

[117] HS 7602: Waste and scrap, of aluminium (excluding slags, scale and the like from iron and steel production, containing recoverable aluminium in the form of silicates, ingots or other similar unwrought shapes, of remelted waste and scrap, of aluminium, ashes and residues from aluminium production)

The unit value of metals scrap is found to be higher than the value of ores and concentrates. Exports of scrap are therefore lucrative. The growing consumption of electronics and automobiles in India has led to piling up of wastes from these industries. Considerable steps need to be taken to accelerate value extraction in this space.

Trade Policy

The import policy for ferrous scrap is unrestricted while for some of the sub-products of copper and aluminium scrap, there are restrictions. The imports of ferrous scrap and waste are exempted from payment of customs duty until FY 2023. The import duty on copper and aluminium scrap on the other hand is 2.5% and 10%, respectively.

Summing Up

As international trade plays an integral role in furthering circular economy practices, the tenuous global value chains for converting waste into resources need to be strengthened. For India, this poses a huge opportunity to boost exports in products like secondary raw materials, refurbished products, spare parts etc. India already has an extensive recycling ecosystem which however is informal in nature. By enabling formalisation of the processes, facilitating movement of waste through efficient channels and developing a robust policy framework, India may emerge as a key player in circular economy related international trade and thereby lead the transition towards circular economy.

Chapter

Global Policy Developments for Transitioning to a Circular Economy

"We cannot solve our problems with the same thinking we used when we created them"

– Albert Einstein

A favourable and enabling regulatory framework is a prerequisite for moving rapidly towards circular economy (CE) across sectors. Policymakers across the globe are faced with the intricate task of accelerating shift towards circular economy models and at the same time, minimising the crippling impact it could have on the stakeholders, mostly on the businesses operating in the informal sector, less privileged consumers etc.

Many countries are drawing ambitious plans to achieve a CE model. Netherlands introduced a Circular Economy Programme in 2016 which aims to have a CE by 2050 and reduce the consumption of primary raw materials by half by 2030. Japan seeks to boost the size of the domestic CE to ¥80 trillion by 2030. The focus areas include circular business models in clothing production and consumption, infrastructure and managing the lifecycle and disposal of items such as batteries and electronics.

Finland's Circular Economy Roadmap 2016-2025 identifies 4 strategic goals and 29 specific actions to cut carbon emissions by half from the level of 2010.

This chapter maps few key developments that have taken place across the world in the policy space for aiding a smooth transition towards CE.

European Union - Circular Economy Action Plan, 2020

The launch of the EU's Circular Economy Action Plan in 2015 was a pioneering step towards taking concrete action for transitioning towards a CE. The plan listed down 54 action points for development of a carbon neutral, resource efficient and competitive economy. A review of the action plan highlights the key developments that have taken place in mainstreaming circularity in the economy.

Subsequently, new Circular Economy Action Plan was launched in 2020. The plan proposes a Global Alliance on Circular Economy and Resource Efficiency (GACERE), an alliance of governments at the global level to work together for a global just circular economy transition and more sustainable management of natural resources[118]. The Circular Action Plan 2020 focuses on the entire life cycle of products and adoption of digital technologies for tracking, tracing, and mapping of resources. To ensure action and accountability, the Plan has introduced pivotal legislation with target implementation dates.

[118] The countries who have joined the GACERE include Canada, Chile, Colombia, the European Union, India, Japan, Kenya, Morocco, New Zealand, Nigeria, Norway, Peru, Republic of Korea, Rwanda, South Africa and Switzerland

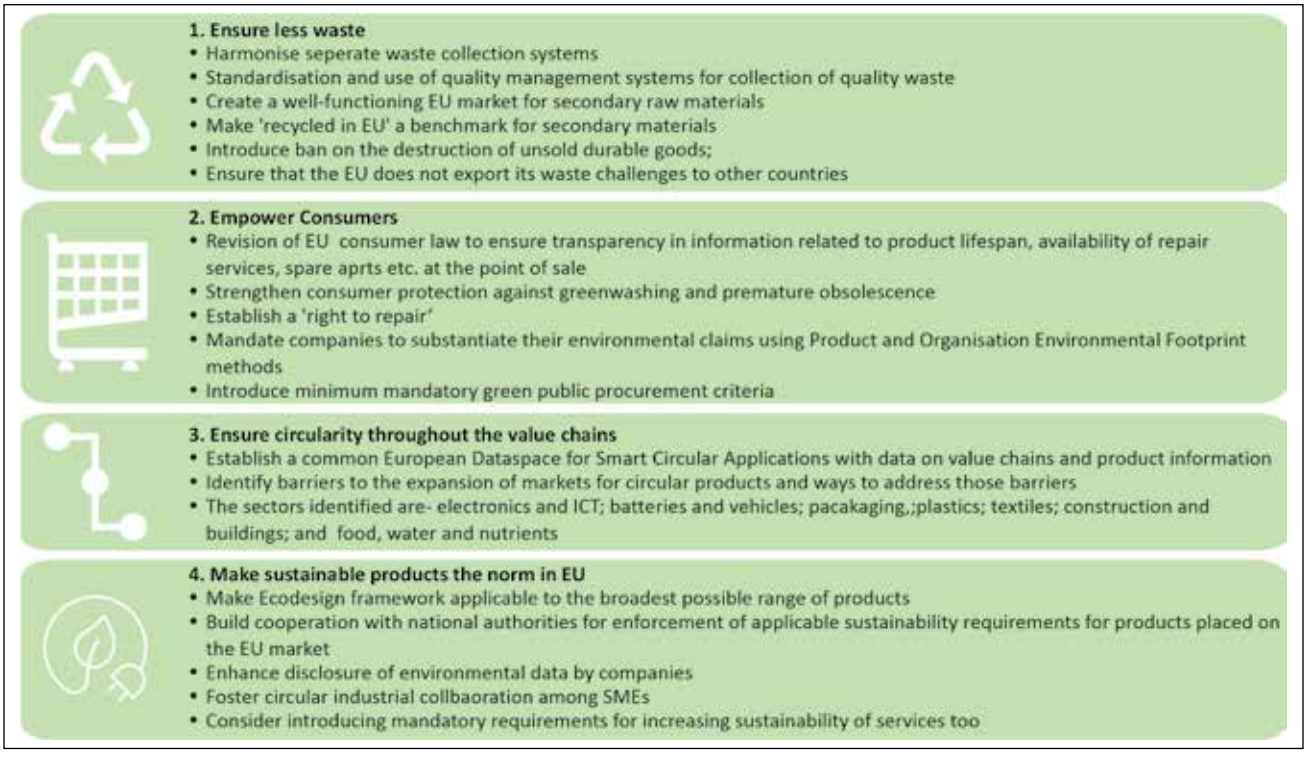
Table 7: Developments under EU's Circular Economy Action Plan, 2015

Area	Development
Circular design and production processes	• Ecodesign Working Plan 2016-2019 implemented. ○ Seven new product groups, namely, electric kettles, hand dryers, elevators, building automation & control systems, solar panels & inverters, refrigerated containers, and high-pressure cleaners included for improving energy efficiency; mandated availability of spare parts[119]
Turning waste into resources	• Revised waste legislative framework entered into force in July 2018. This includes ○ target recycling rates[120] ○ harmonisation of definitions and calculation methods of recycled materials ○ separate collection provisions for waste streams, such as paper, metal, plastic, and glass, to facilitate their recycling
Closing Loops of recovered materials	• Initiated standardisation processes for recovery of critical raw materials
Strategy for Plastics	• Ban on single use plastics • Measures to reduce consumption & regulate labelling of plastic food containers & beverage cups

Source: EU[121]

For instance, tougher battery regulations covering the entire battery life cycle to make batteries more sustainable, performant, and durable; new Ecodesign for Sustainable Products Regulation for more environmentally sustainable and circular products[122]; and the revision of the Packaging and Packaging Waste Directive to ensure reusable or recyclable packaging are among the many upcoming laws under the plan. The core themes of the plan and the actions proposed are given below:

Exhibit 27: Core Themes of the Circular Economy Action Plan, 2020



[119] Spare parts for refrigeration devices (refrigerators, freezers, wine cellars, etc.) must be available for 7 years after purchase; for washing machines, dryers, and dishwashers for 10 years after the purchase.

[120] Reuse and recycling of municipal waste to be increased to 55% by 2025, to 60% by 2030 and to 65% by 2035.

[121] Report From The Commission To The European Parliament, The Council, The European Economic And Social Committee And The Committee Of The Regions on the implementation of the Circular Economy Action Plan

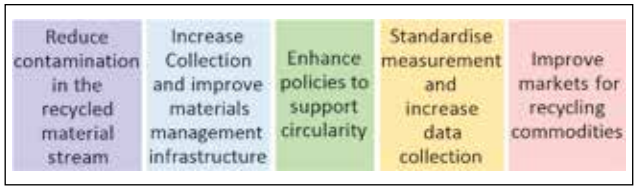
[122] The plan identifies the Ecodesign Directive as an established framework for the setting of Ecodesign requirements for energy-using products.

The key actions proposed for electronics and ICT, batteries and vehicles and textiles in the action plan are discussed later in the chapter.

The National Recycling Strategy, Part One of a Series on Building a Circular Economy for All, USA

In November 2021, the Environmental Protection Agency (EPA) in the United States released a roadmap for achieving the national recycling goal of 50% by 2030 as against the current recycling rate of 32%. The strategy focuses on the residential and commercial recycling system with a number of strategic objectives designed to make recycling more resilient and cost-effective (Exhibit 28).

Exhibit 28: Objectives of the Strategy, USA

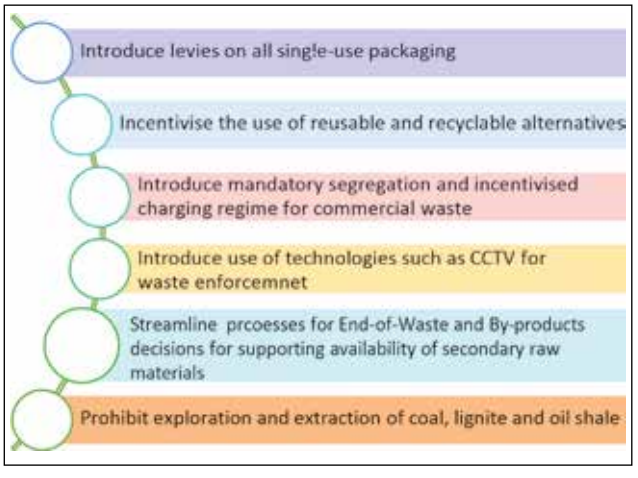


Ireland - Circular Economy and Miscellaneous Provisions Act, 2022

Ireland has passed a landmark law to shift from the linear model of production and consumption to a more sustainable one. It defines the CE for the first time in Irish domestic law[123], re-designates the existing Environment Fund as a Circular Economy Fund and mandates the development of Circular Economy Strategy and National Food Loss Prevention Roadmap, among others. (Exhibit 29)

With the passing of the law, Ireland envisages to be among the first in the world to phase out the use of disposable drink cups by imposing a ban on the use of disposable coffee cups in cafes and restaurants and subsequently introducing a charge on disposable cups for takeaways. Notably, the law makes it a legal requirement to factor in the requirements of the socially and economically disadvantaged communities while preparing the National Circular Economy Strategy. Some of Ireland's existing levies, such as the plastic bag levy and the landfill levy, have been successful in preventing waste, enabling behavioural change, and moving waste management up the waste hierarchy

Exhibit 29: Key Features of the Law, Ireland



France - Anti-Waste Law, 2020

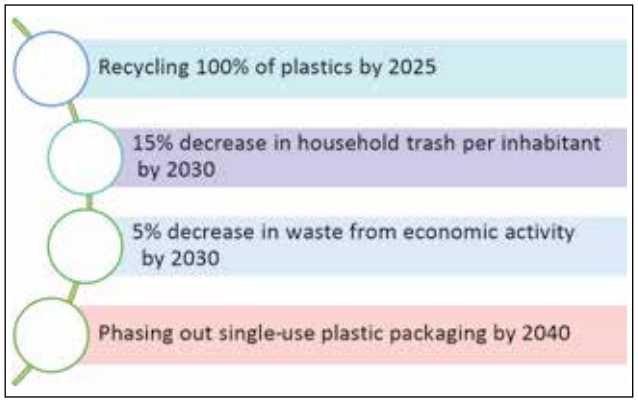
France adopted Anti-Waste Law in 2020 to eliminate waste and pollution from the design stage and expedite transition to a CE model. The pioneering law has introduced several policy measures that are a world first. These include ban on destruction of unsold non-food products such as clothing, shoes, beauty products, books, and consumer electronics[124]. The manufacturers and distributors with unsold inventory of these products are required to donate

[123] Circular economy is defined as an "an economic model and the policies and practices which give effect to that model in which (a) production and distribution processes in respect of goods, products and materials are designed so as to minimise the consumption of raw materials associated with the production and use of those goods, products and materials, (b) the delivery of services is designed so as to reduce the consumption of raw materials, (c) goods, products and materials are kept in use for as long as possible thereby further reducing the consumption of raw materials and impacts harmful to the environment, (d) the maximum economic value is extracted from goods, products, and materials by the persons using them, and (e) goods, products and materials are recovered and regenerated at the end of their useful life";

[124] National estimates of unsold goods destroyed each year range from between €630 million (in France) to €7 billion (in Germany). Root causes and main motivations cited for the destruction of unsold goods include: (i) retaining brand image and price level, ensuring exclusivity, and protecting intellectual property; (ii) damage due to shipment or returns; (iii) costs related to reprocessing, rebranding, or tariffs/taxes; and (iv) overproduction.

or recycle instead of incinerating or dumping these in landfills. Additionally, a mandatory repairability index[125] has been introduced on electronic and electric products to increase the proportion of products that get repaired. The law also prioritises creation of jobs in reuse networks and encourage the donation of unsold goods to charitable organisations.[126] (Exhibit 30)

Exhibit 30: Key Targets Set under the Law, France



The law addresses pertinent issues such as tackling planned obsolescence[127] by making it mandatory for manufacturers and sellers of mobile phones and tablets to provide the time frame to buyers during which their devices are subject to operating software updates and extending the two-year guarantee period against faulty goods sold by the manufacturer to another six months.

For increasing transparency and awareness among the consumers, the law requires the manufacturers to make information related to adherence of their products to circular requirements available to consumers by introducing measures such as mandatory environmental labelling, imposing the provision of information on products containing endocrine disruptors etc. It also obligates internet service providers and mobile operators to provide information pertaining to their data usage to consumers besides the equivalent greenhouse gas emissions so that the impact of their digital consumption can be gauged by the individuals.

Further, the law follows the carrot and stick approach for controlling pollution wherein under the "polluter pays" principle, manufacturers are required to draw five-year eco-design action plans to make their products more recyclable. The manufacturers who succeed to incorporate circularity in the product design will be rewarded with a bonus whereas those who do not do so will be subject to a penalty. Fines up to 15,000 euros will also be imposed on illegal waste dumping besides impounding the vehicle used for dumping.

Evolving regulations in India

Achieving CE is increasingly becoming a national priority in India. To expedite the transition, 11 sectoral committees have been formed to prepare comprehensive action plans. The sectors covered are ferrous and non-ferrous metals; lithium-ion batteries; tyre and rubber recycling; gypsum; end-of-life vehicles (ELVs); electronic waste; toxic and hazardous industrial waste; municipal solid and liquid waste; agriculture waste; used oil waste; and solar panels. Several rules pertaining to efficient use of resources and waste minimisation have also been notified such as the Plastic Waste Management Rules, 2016, further amended in 2018 and 2022; E-Waste Management Rules, 2016, amended in 2018; Construction and Demolition Waste Management Rules,2016; and the Steel Scrap Recycling Policy, 2019.

Notably, the second amendment to Plastic Waste Management Rules imposed a ban on manufacture, stocking, distribution, import, sale, and use of several Single Use Plastic (SUP) items such as cups,

[125] A repairability index allows the consumers to know whether his/her product is repairable, difficult to repair, or non-repairable. The index (a score out of 10) is affixed directly on the product or its packaging, and at the point of sale. It is displayed on a number of electric and electronic products of general consumption such as smartphones, laptop computers, washing machines and television.

[126] Companies will be asked to financially support actors involved in reuse through employment (waste sorting and recovery centres, recycling centres etc.

[127] It is the practice of designing products to break quickly or become obsolete in the short to mid-term. This is done to encourage sales of new products and upgrades. For example, a laptop manufacturer may decide to use parts that have a maximum lifespan of five years, instead of parts that could last 20 years.

plates, glasses, cutlery, earbuds, PVC banners, wrapping sheets etc. that have "low-utility and high littering potential".

Furthermore, the Ministry of Environment, Forest and Climate Change has released Draft National Resource Efficiency Policy (NREP). The policy is guided by the principles of "reduction in primary resource consumption to sustainable levels, creation of higher value with less material through resource efficient and circular approaches, waste minimisation, and creation of employment opportunities and business models beneficial to the cause of environmental protection and restoration". To begin with, the policy proposes resource efficient strategies for automotive, plastic packaging; building and construction, electrical and electronic equipment; solar photovoltaic; steel sector; and aluminium sectors.

Sector-wise Global Policy Developments

Electronics

By the end of 2024, all mobile phones, tablets, and cameras sold in the EU will have to be equipped with a USB Type-C charging port as per the law passed by the parliament in October 2022. This would obviate the need for consumers to buy a different charger every time they purchase a new device. One single charger would suffice for a whole range of small and medium-sized portable electronic devices.

By 2026, the obligation will extend to laptops. This is just one instance of the monumental changes happening worldwide in a bid to transition to circular models. Few of the policy developments are outlined below: -

Table 8: Select Policies related to Circular Economy in the Electronics Sector

Country/ Region	Policy Interventions Implemented/ Planned
EU	- Introduce a Circular Electronics Initiative to promote longer product lifetimes - Create regulatory measures for electronics and ICT including mobile phones, tablets and laptops under the Ecodesign Directive - Focus on Electronics and ICT as a priority sector for implementing "Right to repair" including a right to update obsolete software - Regulatory measures on chargers for mobile phones and similar devices, including the introduction of a common charger - Improving the durability of charging cables, and incentives to decouple the purchase of chargers from the purchase of new devices - Create an EU-wide take back scheme to return or sell back old mobile phones, tablets, and chargers - Review EU guidelines for hazardous substances
Austria	- A publicly financed repair bonus introduced for reimbursing a part of the repair costs incurred by the consumers. Up to 50% of the repair costs reimbursed, with a cap of 100 euros per repair case or per year, usually.
UK	- Introduced right-to-repair rules that legally require manufacturers to make spare parts available to people buying electrical appliances.
France	- Mandates companies to display a repairability score out of 10 for smartphones, laptops, televisions, washing machines and lawnmowers. Different colour variations to be displayed to make it easier for consumers to gauge the score.

India

India is the only country in Southern Asia having an e-waste legislation, with e-waste rules brought into place since 2011. The rules mandate that only authorised dismantlers and recyclers collect e-waste.

The rules were further revised in 2016. The E-waste (Management) Rules, 2016 require manufacturers of electrical and electronic equipment including components, consumables and spares and parts to collect a certain percentage of e-waste generated from the goods once they reach their 'end of life' as per the principle of Extended Producer Responsibility (EPR).

In 2018, the collection targets were revised by 10% every year until 2023. The responsibility is entrusted on the producers for collection, transportation, storage, dismantling, recycling, and disposal of the equipment. The framework allows the manufacturers to employ Producer Responsibility Organisations (PROs) approved by the CPCB to oversee these operations. This incentivises manufacturers to, inter alia, focus on eco-design, reduce fast obsolescence, enhance recycling and recovery of secondary resources thereby promoting circularity in the sector.

In November 2022, E-Waste (Management) Rules, 2022 were notified and will come into effect from April 1, 2023. While the rules apply to all manufacturers, producers, refurbishers, dismantlers and recyclers of e-waste, it is the responsibility of the manufacturer to ensure adequate recycling and refurbishing of the e-waste through adherence to extended producer responsibility (EPR) obligations. Notably, the rules incentivise refurbishing through mandating EPR for only 75% of the refurbished quantity for recycling upon expiry of the product life. The rules also mandate reduction in the use of hazardous substances, namely, lead, mercury, cadmium, hexavalent chromium, polybrominated biphenyls and polybrominated diphenyl ethers in the manufacturing of electronics[128]. Furthermore, the producers have to ensure collection and recycling of at least 60% of their electronic waste by 2023 with targets to increase it to 80% by 2027-2028. The other notable provisions include increase in the range of electronic goods covered, imposition of environmental compensation for failure in compliance and earmarking industrial space for e-waste dismantling and recycling facilities, among others.

Furthermore, in January 2022, the Bureau of Indian Standards has published standards for USB Type-C port, plug and cables for use in various electronic devices . The standard provide common charging solutions for the smartphones and other electronic devices sold in the country to enable reduction in number of chargers per consumer. The Indian government has also announced the mandatory USB Type-C charging for all mobile phones and tablets sold in India after March 2025.

The Ministry of Electronics and Information Technology has also formulated an action plan for implementation of CE principles in the sector. This plan focuses on lifecycle of electronics starting from raw material acquisition, design and production to e-waste management and secondary raw materials utilization. Some of the recommendations in the action plan are integration of informal sector in the e-waste management system through setting up of industrial clusters, strengthening capacity building programmes for stakeholders, standardisation of technologies for material extraction and making a certain percentage of secondary materials usage mandatory in manufacturing processes.

[128] The Rules mandate that producers should ensure that new electrical and electronic equipment and their components or consumables or parts or spares do not contain Lead, Mercury, Cadmium, Hexavalent Chromium, polybrominated biphenyls and polybrominated diphenyl ethers beyond a maximum concentration value of 0.1% by weight in homogenous materials for lead, mercury, hexavalent chromium, polybrominated biphenyls and polybrominated diphenyl ethers and of 0.01% by weight in homogenous materials for cadmium

Textiles and Apparels

As noted earlier, fashion industry is the second most polluting industry in the world. Strong measures are thus required for facilitating a structural change in the industry. Currently, very few countries have designed concrete policies for addressing the challenges related to sustainability in the sector (Table 9).

Table 9: Select Policies related to Circular Economy in the Textiles and Apparels Sector

Country/Region	Policy Interventions Implemented/ Planned
EU	- Design comprehensive EU Strategy for textiles - Develop eco-design measures to ensure that textile products are fit for circularity - Empower business and private consumers to choose sustainable textiles and have easy access to re-use and repair services - Provide incentives and support to product-as-service models and circular materials and production processes - Provide guidance to achieve high levels of separate collection of textile waste - Boost sorting, re-use, and recycling of textiles, including through innovation, encouraging industrial applications and regulatory measures such as EPR
France	- First country in the EU to pass EPR laws - Destruction of unsold clothing prohibited - Manufacturers or importers of clothing, linen, and footwear (CLF) products must either set up their own officially accredited collection and recycling program or register with an accredited take-back system. - Fashion online retailers selling textiles to France via Amazon's marketplace need to show their EPR number as proof of compliance.
Sweden	- Passed EPR laws on textiles and clothing - Target to reduce textile waste by 70% in weight by 2028, compared to 2022 baseline data. - Regulations to be supplemented by supportive measures to compensate for extra costs
China	- Aims at recycling 25% of its textile waste and produce 2 million tonnes of recycled fibre by 2025[129] - Have a waste textile recycling system 'initially established' by 2025 - Promote green design and use of green fibres in textiles - Promote the application of China Social Responsibility Management System for Textile and Apparel Sector in enterprises - Strengthen technological innovations

[129] As per the document 'Implementation Opinions on Accelerating the Recycling of Waste Textiles', jointly released by the National Development and Reform Commission (NDRC), the Ministry of Industry and Information Technology and the Ministry of Commerce.

India

Textiles and apparels sector has not been recognised as a focus sector for preparing action plans for transitioning to circular business models. Nevertheless, NITI Aayog is in the process of designing policies to encourage the industry to move towards a circular economy.

Automobiles

Many vehicle manufacturing countries have robust policies for End-of-life Vehicles (ELV)[130] disposal since decades while most of the other countries, have an informal recycling ecosystem, largely. Policy interventions for circular process in the sector are highlighted in Table 10.

Table 10: Select Policies related to Circular Economy in the Automobiles Sector

Country/Region	Policy Interventions Implemented/ Planned
EU	- ELV Directive adopted in 2000 o Restricts use of toxic metals in vehicles to minimize the release of such pollutants[131] o Facilitates dismantling and recovery of materials for re-use and recycling o Target rates revised to ≥ 85% for recycling and ≥ 95% for recovery in 2015 o Manufacturers responsible for reclamation of their vehicles sold on the market[132] - Circular economy Action Plan, 2020 o Proposes a new regulatory framework for batteries. o Create rules on recycled content and measures to improve the collection and recycling rates of all batteries o Address non-rechargeable batteries to phase out their use o Ensure ethical sourcing of raw materials and security of supply o Revise the rules on end-of-life vehicles to include mandatory recycled content for certain materials of components and improve recycling efficiency o Consider the most effective measures to ensure the collection and the environmentally sound treatment of waste oils. o Apply product-as-service solutions
Japan	- Law for recycling of ELVs in place since 2005. o Based on EPR, manufacturers and importers are obliged to collect and recycle air bags and shredders and destruct CFCs o Fees for recycling paid by owners of vehicles, generally at the time of purchase o Electronic manifest system introduced for reporting information on transfer and treatment of ELVs

[130] End-of-life vehicles are motor vehicles that are categorised as waste. Their components and materials are also classed as waste.
[131] The directive prohibits the use of hazardous substances when manufacturing new vehicles (especially lead, mercury, cadmium, and hexavalent chromium) except in defined exemptions when there are no adequate alternatives. E.g. lead-acid batteries, which were traditionally used in vehicles, are being replaced by lithium-ion batteries, which do not contain lead. Additionally, manufacturers are using alternative materials, such as aluminium and composites, in the construction of vehicle components, which reduces the need for lead-based materials.
[132] All economic operators need to set up systems for the collection, treatment, and recovery of end-of-life vehicles. Vehicle manufacturers take responsibility for the substitution of hazardous substances and for the cost-free delivery of all ELVs to authorised treatment facilities (ATFs), i.e. dismantlers and/or recyclers. It is the legal obligation of a vehicle's last owner to not abandon it at the end of life, but to hand it over to an ATF.

Country/Region	Policy Interventions Implemented/ Planned
China	- Swap the old for remanufacturing policy provides subsidies to enterprises that collect ELVs and component parts - Establishment of dedicated industrial parks for remanufacturing - Introduced pilot program in 2021 to implement EPR scheme for automobiles. It aims at achieving the following by 2023: - o Significantly increasing the rate of standardized[133] ELV recycling and developing a reproducible model of ELV recycling for manufacturers o Increase the recycled portion of the ELV body in phases to achieve a comprehensive recycling level of 75% o Develop a green supply chain system to increase the vehicle recycling rate to 95% o Ensure at least 5% of each key part of vehicles is made of recycled materials
South Korea	- Act on Resource Circulation of Electrical and Electronic Equipment and Vehicles passed in 2007 o Regulates the use of toxic substances (e.g., cadmium, hexavalent chromium, lead, and mercury) in vehicles o Establishes a resource recycling system for the efficient use of resources[134] o Mandatory target recycling rate of 95% including 10% energy recovery updated in 2015

India

In India, the Ministry of Road Transport and Highways and the Department for Promotion of Industry and Internal Trade have been entrusted with the task of preparing a comprehensive action plan for promoting circularity in disposing End-of-life vehicles (EV) in India and tyre and rubber recycling, respectively. As per the ministry, using materials from scrapped vehicles may lead to 33% reduction in the raw material cost and 10-12% boost in sales.

The launch of Vehicle Scrappage Policy in 2021 marked a watershed moment for the ELV ecosystem in India. The strategy aims at phasing out unfit, polluting vehicles to achieve a lower carbon footprint in the country. It aims to scrap commercial and private vehicles older than 15 and 20 years, respectively if they fail the fitness test. For the testing purpose, Automated Testing Stations with state-of-the-art facilities have been set up on a public-private partnership model. For voluntary disposal of ELVs, discounts are being proposed. (Exhibit 31)

Exhibit 31: Benefits Envisaged under the Vehicle Scrappage Policy, 2021

[133] Clear production standards and specifications have been set for remanufactured products

[134] Manufacturers/importers shall establish a collection system to recycle waste from products released by them, distributors shall ensure that recyclable resources are circulated efficiently by collecting waste electrical and electronic equipment, recyclers shall ensure that as much recyclable resources are recycled as possible so as to save resources etc.

Chapter

Strategies for Transitioning to a Circular Economy

Circularity can play an integral role in transforming our linear economy into one where waste and pollution are eliminated, products and materials are reused, and nature is regenerated.

The production systems in India must adopt practices around the principles of circular economy so that they not only reduce resource dependency, but also gain competitiveness. It is estimated that circular economy adoption in India would translate to annual benefits to a tune of ₹ 40 lakh crore (US$ 624 billion) by 2050 and reduce GHG emissions by 44% compared to the current development path [135].

This chapter suggests strategies that India could potentially adopt and incorporate in its policy framework for its gradual transitioning towards a circular based economy. (Exhibit 32)

A. Develop an attractive market for secondary raw materials-

As discussed earlier, secondary raw materials are recycled materials that can be used for manufacturing products instead of, or in addition to, virgin raw materials. Recycled metals can, to a considerable extent, displace the demand for virgin production and limit the negative environmental impact emanating from extraction and processing activities such as mining, smelting, and refining.

For example, for aluminium, the energy and carbon footprint savings achieved by recycling, compared with primary production for 100,000 tonnes would be 4,434 terajoules (TJ) of energy and 627 kt CO_2e (CO_2 equivalent) of CO_2 emissions. And in the case of ferrous metal production, for 100,000 tonnes, savings are 206 TJ of energy and 29 kt CO_2e of CO_2 emissions[136]. (Table 11)

Table 11: Savings achieved through recycling

100,000 tonnes production of	Saves energy by	Saves carbon footprint by
Aluminium	4,434 TJ	627 kt CO_2e
Ferrous metal production	206 TJ	29 kt CO_2e

However, the current recycling rates of metals are not commensurate with the increasing global

Exhibit 32: Select strategies for Moving Towards a Circular Economy

[135] Ellen Macarthur Foundation. Circular economy in India: rethinking growth for long-term prosperity

[136] Report on the Environmental benefits of Recycling- 2016 edition. Bureau of International Recycling

demand. The share of the demand for many secondary raw materials such as biowaste, plastic, construction materials and textiles with respect to total market size has found to be low even in the EU which has a relatively more developed secondary raw materials market[137].

The supply of secondary raw materials is also not streamlined with lack of performance guarantees mechanism, standardisation, and less consistency in availability. Thus, as both the demand and supply of secondary raw materials are much below potential currently, developing secondary materials markets is akin to a chicken and egg problem.

To tackle this, both the supply and demand sides should be parallelly developed.

1. **Establish quality standards with international cooperation:** Flow of standardised secondary raw materials is imperative for developing a flourishing market not only for domestic consumption but for boosting exports as well. Internationally accepted standards are required to produce homogeneous, predefined and stable-quality secondary raw materials. While some standards exist for certain product categories such as for recycling of aluminium beverage cans and used aluminium packaging in the EU for obtaining aluminium alloys, foam, and low carbon steel and for e-waste for extraction of aluminium scrap, ferrous scrap, copper scrap, circuit boards, glass and mineral fractions, a comprehensive set of standards for a broad range of secondary raw materials is missing.

   India as a member of the Global Alliance on Circular Economy and Resource Efficiency (GACERE) should push for joint negotiations among the member countries, particularly the EU to establish common standards for assuring quality and smooth cross-border flow of secondary materials. This would ensure that India's standards for secondary raw materials are at par with the international standards thereby giving it a head start to become a major secondary raw material exporter. The forum may also be used for exchanging technology and technical knowhow related to the standards.

2. **Nudge producers to use secondary raw materials:** To mainstream the use of secondary raw materials, financial schemes need to be designed that nudge producers to diversify their sources of raw materials away from the primary sources. One such scheme could be offering annual corporate tax benefits to producers who exceed the stipulated minimum percentage use of secondary raw materials out of total raw materials. The threshold for use of secondary raw materials may be based on the total sales of the company in that particular area. As the pricing systems of secondary raw materials are not so developed right now, the schemes may ensure that there is net benefit to the company from greater use of secondary raw materials as compared to their peers who are not using these.

3. **Improve information and monitoring of secondary raw material markets:** Unlike primary materials, market information pertaining to secondary raw materials such as prices, quantity processed and its trade etc. is not transparent, particularly in less developed markets. Information about the market players, the environmental benefits of using these materials, different types of quality available etc. are also not readily available to potential users.

   A monitoring mechanism needs to be put in place to track the penetration of secondary raw materials in the market.

   Further, for ensuring that all necessary information is available with the stakeholders, a website may be developed under the Waste to Wealth mission for listing daily prices of secondary raw materials such as black mass

[137] European Environment Agency. (2022). Investigating Europe's secondary raw material markets,

(Recycled ELV lithium batteries), grade-wise recycled copper etc., list of manufacturers, recycling processes used, applications etc. of the secondary raw materials.

With the increased formalisation, in the medium run, a secondary raw material trading platform may be introduced and regulated.

Box 4: EU's criteria for 'well-functioning' secondary market

According to EU's secondary raw material (SRM) market assessment, a well-functioning market has:

- a significant share of the total market for that material (including the primary material market
- representative prices properly reflecting demand-supply interactions;
- international or a wide scope of transactions;
- adequate economic drivers, even without support from (waste) policy
- robust industrial capacity for recycling;
- good availability of market information; and
- good product standardisation

The EU applies these criteria to eight common SRM markets targeted for its waste policy. These include aluminium, paper and cardboard, wood, glass, plastics, textiles, construction and demolition aggregate waste and biowaste. Of these, only three are assessed to be well functioning, namely aluminium, paper and glass.

Source: Investigating Europe's secondary raw material markets, European Environment Agency

B. Incentivise Responsible Consumption

According to a survey by Capgemini which was undertaken to gauge the level of awareness among consumers about circular economy[138], only 53% of the respondents in India were aware about the magnitude of textile waste generated globally. However, at 62%, the awareness regarding inadequate e-waste recycling was the highest among the respondents in India as compared to other countries. Moreover, the survey showed the willingness of consumers to adopt circular practices such as purchasing zero-waste products, extending product life and responsible product disposal.

The decent level of awareness and willingness to switch to circular practices among the consumers, however, have not led to a considerable shift in behaviour due to several roadblocks. Asymmetry in information about second hand products, apprehensions about quality, high repair costs and costs of adopting other circular practices are some of the main concerns that consumers have.

1. **Circular Economy Labelling on Products:** In India**,** the Bureau of Energy Efficiency mandates star labelling of select electronics to gauge the energy performance. This has had a major impact in influencing consumers' buying decisions towards more energy-efficient devices. In a similar manner, national labelling standards for products manufactured through circular practices such as using secondary raw materials instead of virgin products, refurbishing, through zero waste processes etc. may be developed to enable more responsible buying and to serve as a guarantee of quality.

   The Ministry of Consumer Affairs along with the Bureau of Indian Standards may form a committee to identify the circular manufacturing processes to be covered and for setting the minimum quality and quantity standards under each practice to qualify for the labelling. This would help equip the consumers to deal with the information asymmetries and greenwashing claims that they are currently faced with.

2. **Voluntary Registration and Incentives for Repair Shops:** As a landmark step towards consumer empowerment, the Ministry of Consumer Affairs, Government of India, has set up a committee to formulate the "Right to Repair" framework in India. The right

[138] Capgemini Research Institute. Circular Economy for Sustainable Future

to repair law would make it mandatory for manufacturers to share product and repair details and ensure accessibility of spare parts so that customers can either undertake repairs themselves or through third parties. This would help eliminate a considerable amount of e-waste that is being generated due to high repair costs or lack of repair options as a practice to further planned obsolescence or to monopolise repair operations by the producers. The sectors to be covered preliminarily will be farming equipment; mobile phones and tablets; consumer durables; and automobiles and automobile equipment.

Repair businesses in India, particularly for electronics are quite widespread. The Right to Repair framework would lead to further proliferation of repair shops in India. However, given the current informal nature of the sector, consumers may be apprehensive about the quality of services provided. To enable standardisation of services, the concerned ministries for the products covered under the Right to Repair framework may start a voluntary registration process for repair shop owners. Facilities like trainings, technology upgradation, concessional financing etc. may be provided to the businesses on the condition that they follow the standard procedures set by the regulating authorities and provide quality services with a resolution system for customer grievances.

Standardised repair services in sectors such as automobiles, electronics and mechanical equipment would enable customers to go for quality repair services, thereby extending the products lives and reducing waste.

3. **Providing Support to Companies selling circular solutions to consumers:** According to European Environment Agency (EEA), consumer electronics like smartphones, televisions, washing machines and vacuum cleaners have average actual lifetimes that are at least 2.3 years shorter than their designed or desired lifetimes. This implies that the lifecycle of such goods can be extended by providing services such as repair, refurbishing and remanufacturing. Similarly, according to the Waste & Resources Action Programme, extending the average life of clothes by just nine months would save £5 billion in resources used to supply, launder, and dispose of clothing.

   Many companies, realising the gravity of the problem as well as sensing the business opportunities in the segment, have come up with innovative business models to provide circular solutions. For example, in textiles and apparels sector, companies connecting buyers and sellers of second-hand clothing with the assurance of quality and traceability are on the rise. In the electronics sector, companies with end-to-end recycling solutions are making a mark. Companies selling Extended Producer Responsibility (EPR) solutions for circular economy are also coming up.

Table 12: Select Indian Companies working in the Circular Economy Space

Company	Area
Relove, Kiabza	Resale marketplace for clothing
AltMat, Descatuk	Textiles out of agri-waste
Geetanjali Textiles, Flax Apparels	Recycling of post-consumer clothing waste
Attero, Reteck, Namo e-waste	Recycling of e-waste
Karo Sambhav	EPR programmes for e-waste management
BATX Energies	Recycling of end-of-life lithium-ion cells

Source: India Exim bank Research

However, being a nascent segment, the businesses face challenges and require support from the government to scale up their operations.

Firstly, the Government of India may provide marketing support to help these companies reach a larger market, both domestically and internationally.

Secondly, as many of these companies have effective solutions but not the wherewithal to implement them at a nationwide scale, the GOI may offer its existing distribution networks and infrastructure for purposes such as collecting e-waste and used garments, spreading awareness at the grassroots level etc.

Thirdly, an interest subvention scheme may be launched for promoting business activities that provide circular economy solutions. To ensure scalability, a minimum threshold for companies' turnover may be set for the scheme.

4. **Rewarding Consumers for Behavioural Changes:** Incentives systems may be set up that nudge consumers to make positive behaviour changes. For example, consumers that drop-off their recyclable/ reusable waste at dedicated collection spots may be offered cash benefits. Hitherto, the take-back schemes promoted by companies mostly offer coupons to be used for buying additional products of the companies. This limits the buying choices for consumers. Providing discounts on products made out of secondary raw materials may also help in driving consumption for such products and assuaging the apprehensions that consumers have regarding the quality and utility of second-hand products. Opening up refurbishing centres for electronics, clothes and other items and providing services at pocket-friendly prices may also encourage consumers to extend the life of their products instead of disposing them.

C. Boost Trade for a Circular Economy

1. **Strengthen and Ensure Enforcement of Import Standards:** For the development of India's informal recycling ecosystem to be profitable, there needs to be sufficient level of scale. When it comes to energy recovery, the lower investment needed for waste incineration (i.e., combustion of substances contained in waste materials) compared with recycling is a particularly relevant economic barrier for secondary raw material (SRM) markets. Incineration plants require large investments and depend on sufficient volume of waste feedstock being available. Import of regulated waste for processing in India could thus further profits for the recycling industry. Furthermore, as noted in Chapter 3, despite several restrictions on imports of items considered waste, such as used electronics, worn apparels and other second-hand goods except capital goods, imports have been increasing, indicating the high demand. It would be worthwhile to strengthen import standards for second-hand product categories / waste to bolster the domestic recycling industry and make India a major export hub for secondary raw materials and refurbished products.

   In this regard, China's Operation Green Fence can serve as an importance case study. In 2013, owing to the falling quality of recyclable waste imports, China started to reject poor quality shipments coming from countries such as the US and the EU and tightened inspection regimes for existing policies. This move not only put a check on imports of heavily contaminated recyclables but also provided support to the domestic recycling industry. The recyclers in the exporting countries had to invest in new technology and processes to ensure adequate quality of the export materials. China's actions thus led to upgradation of global recycling chains[139].

   Therefore, India may strengthen its imports standards for waste and second-hand products wherever needed with the objective of supporting the domestic recycling industry and ensure strict enforcement of the same.

2. **Build Circular Value Chains through Trade Agreements:** Comprehensive trade agreements can play a key role in enabling rapid transition of countries towards circular economy practices. Although circular economy related references are being incorporated in

[139] Waste 360. (2016). What Operation Green Fence Has Meant for Recycling

many trade agreements, the scope remains limited. For example, the EU–Mexico Global Agreement, the EU-New Zealand Free Trade Agreement (FTA) and the EU-Australia FTA recognize the importance of cooperation for promoting circular economy.

Similarly, proposed drafts of the EU–New Zealand FTA and the EU–Australia FTA include references to cooperation aimed at promoting a CE[140]. As a matter of fact, EU envisages to mainstream circular objectives in all of its free trade agreements as a part of its Circular Action Plan 2020.

With the negotiations between India and the EU for an FTA going on in full swing, India has the opportunity to establish best international practices for circular economy practices in cooperation with the EU.

The focus areas in the trade agreements could be-

- Working on a common classification list of goods related to the CE: While the recent HS classifications are in the process of including such goods, at present there is no common international categorisation for circular economy goods. Under trade agreements, second hand products, waste, secondary materials etc. may be categorised differently thereby facilitating regulated movement of the different categories.
- Promoting supportive services such as design, engineering, research and development, and digital services. For example, India has the potential to emerge as a global hub for electronic repair services. This can be tapped through building mutual cooperation and granting reciprocal access.
- Identifying avenues for investments for building circular value chains. A conducive environment for investments would enable transfer of technology and knowledge.
- Enabling harmonization of standards and regulations for free flow of cross border trade.

3. **Introduce Green public procurement (GPP) criteria in Trade Agreements:** In March 2022, India for the first time included the Public Procurement Clause in its Comprehensive Economic Partnership Agreement with the UAE. This grants UAE-based companies' treatment at par with domestic companies for accessing government procurement contracts worth over ₹200 crore. Many other countries such as the EU, UK and Australia are also eyeing at India's lucrative US$ 500 billion procurement market. Given the high international interest, the Government may consider including GPP clauses pertaining to recyclability or recycled content in the upcoming FTAs. The EU under its Circular Action Plan 2020 has already proposed minimum mandatory GPP criteria and targets. The most common criteria include thresholds for chemical substances and the recycled content in products, both conducive for developing secondary raw material markets. Thus, to start with, India may introduce GPP clauses in the FTA with the EU. To ensure proper implementation, robust monitoring systems may also be established. The GPP clause in the medium run would also enable Indian companies to adopt best practices in the use of secondary raw materials in their products both for domestic and international use.

D. Establish robust recycling ecosystem

1. **Improve collection of waste:** Improving the collection of waste is an essential step towards creating a circular economy. Many countries have stringent laws for minimising contamination of waste. In India, the collection system for waste, including e-waste, is still in its early stages of development and is facing several challenges. The system is fragmented, with different states and municipalities having different policies and programs for waste collection and management. This leads to disparities in the quality of services and

[140] IISD & SITRA (2021). Options to Incorporate Circular Economy Provisions in Regional Trade Agreements

lack of standardization across the country. Furthermore, policies are mainly made for collection of e-waste predominantly, ignoring other significant waste streams such as textiles and metals.

Many e-waste collectors operate informally, with little regulation, and often resort to dangerous and harmful practices such as burning and manual dismantling. The coverage of take-back schemes by producers and registered recyclers is very limited. As noted in Chapter 2, India collected only 3.5% and 10% of the e-waste generated in the country for recycling in 2017-18 and 2018-19, respectively.

The recent policies such as the scrappage policy for End-of-Life Vehicles (ELVs) and the E-waste management rules 2022 are expected to considerably improve collection systems. In addition, the government may take several steps to enhance collection rates and quality. Firstly, awareness campaigns may be conducted through various mediums such as TV, radio, print, and social media to educate the public about the importance of e-waste management and to encourage them to participate in the e-waste collection and disposal process. Secondly, the collection infrastructure such as e-waste and clothes collection centres and scrappage centres in case of automobiles needs much more penetration. Thirdly, partnerships with private sector are needed to set up e-waste management.

2. **Support formalisation of recycling units**: As of April 2022, there were a total of 472 dismantlers/recyclers authorised by the State Pollution Control Boards (PCBs)/ Pollution Control Committees (PCCs), with a recycling capacity of 14.3 lakh MTPA while the quantum of e-waste exceeds 3 million MTPA. Moreover, majority of formal recyclers currently operate much below their capacity, wherein they are not even processing half of the authorised quantum of waste. Compared to this, there are a plethora of informal recycling clusters across the country which are devoid of uniform standards, adequate technology, and safe working conditions. For example, in textiles, most recycling units in India are not able to produce high-quality recycled yarn due to technological limitations because of which they fetch low prices for their products and are mostly utilised in domestic market. The advanced mechanical and chemical recycling technologies remain inaccessible due to large investments required. Particularly, the chemical recycling technologies across deferent sectors are out of reach for these recyclers. A multipronged approach is needed to enable their formalisation.

   Firstly, recycling parks with common infrastructure upgraded with latest technology need to be set up at the identified clusters. This would help the small units to avail facilities which they otherwise may not be able to afford along with better price realisation. Secondly, comprehensive trainings may be provided to the recyclers regarding the best practices to be adopted with focus on building export capabilities parallelly. Thirdly, as advanced recycling techniques require higher quality feedstock; robust supply chain management may be ensured to guarantee a continuous flow of waste and thereby continuity in supply of secondary raw materials to the users.

E. Better product design

The design stage is extremely critical as it determines nearly 80% of the products' environmental impacts in terms of energy consumption, life span, repair, reuse, recyclability, and waste handling[141]. Therefore, a pre-planned approach towards circular economy is needed to restrict the use of excessive materials, minimise the use of toxic materials, enable easy dismantling and limit product obsolescence, among others.

1. **Build capabilities for zero-waste designs**: To adopt to minimal waste in the manufacturing process, suitable pedagogy should be introduced at educational institutes engaged

[141] Ellen Macarthur Foundation. Recycling and the circular economy: what's the difference?

in arts, science, technology, etc. This possibly could be as a minor paper for greater knowledge and practice during their degree course.

As designers lay the foundation for a product, its uses, duration of life, extent of waste creation etc., it is extremely important that they get the right kind of training at the initial stages so as to ensure that lesser wastes go ahead in the process ahead. A study by Gam and Banning (2020) ascertained that teaching zero-waste design methods in fashion designing courses positively influenced students' awareness of sustainable practices[142]. Thus, some of the steps that may be taken for encouraging learning could include amongst others - i) Introduction of mandatory courses and modules on zero waste design, sustainability, and circular economy ii) incorporation of hands-on activities and projects that promote the principles of circular economy, and iii) build industry partnerships with organisations working in the field to promote practical learning as well as to provide a platform to students for piloting projects.

Furthermore, Centres for Circular Economy may be set up for promoting dedicated research in all major design institutes in India such as the National Institute of Design (NID), Indian Institute of Technology (IIT), and the National Institute of Fashion Technology (NIFT). Funds may also be allocated for setting up incubation centres in the institutes.

Box 5: Students pioneering zero-waste designs

A student at National Institute of Design, Ahmedabad has won accolades for originating the concept of Earth Tatva, a mono-material made from recycled post-industrial fired ceramic waste. Globally, approximately 2,50,000 tonnes of tiles wear out every year and another ten crore tiles go into repairs. In India, just one sanitary ware cluster produces about 21,600 tonnes of waste fired ceramic pieces in a year. The mono-material can be recycled for multiple production cycles and is reported to be 35% stronger than traditional ceramics by the Central Glass and Ceramic Research Institute (CGCRI).

The mass adoption of the material has advantages such as reduction of mining of resources used to make ceramic products, productive disposal of waste through recycling, energy and cost-effectiveness and quick casting time for production. By creating education-industry linkages for such breakthrough ideas, sustainable designs can become the new normal in manufacturing.

The company has been recognized as 'Circular Economy Pioneer' Ellen Macarthur Foundation and is also the winner of awards such as 'The James Dyson Award'.

Source: India Exim Bank Research

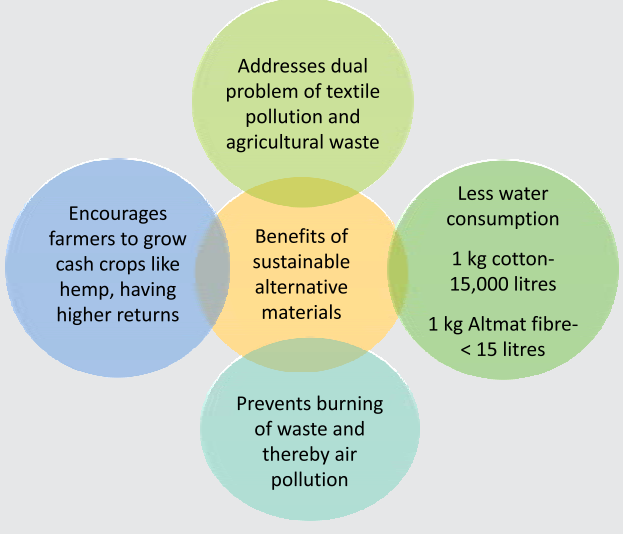
2. **Incentivise use of sustainable materials:** In apparels, cotton and man-made fibres are the major raw materials used. As noted earlier in Chapter 2, India's excessive reliance on cotton as well as materials such as polyester, acrylic and nylon put a huge strain on natural resources. There is a need to introduce alternate materials that are less water and energy intensive, easily recyclable, and more durable. A slew of government initiatives is needed to drive the industry as well as the consumers towards use of biomaterials. Though many companies are coming up with sustainable clothing materials such as those

[142] Gam and Banning. (2020). Teaching Sustainability in Fashion Design Courses Through a Zero-Waste Design Project

made from agricultural waste, massive scaling up needs to be done which is not possible without government support. Infrastructure support and fiscal incentives such as lower GST rates for companies working in this space and R&D grants to institutions for carrying out feasibility studies may serve as the stepping-stones for developing a bio-material industry.

Box 6: AltMat, a company manufacturing textile fibre out of agricultural waste

AltMat is an Alternative Materials Science company, based out of Gujarat, which upgrades agricultural residues into high performing natural materials, using their proprietary technology. The materials are divided into three categories: Alt yarns, Alt fibres and Alt fabrics. Alt fibres are made from hemp oil seed, banana, and pineapple residues and available in several grades for different applications like paper making, packaging, non-woven, hygiene products and composites. The challenges highlighted by the company in scaling up are lack of awareness and education about the meaning of sustainability among stakeholders, lack of impact measuring processes which could have helped in rewarding circular economy innovations and inadequate public research in India.



Source: Centre for Responsible Business

F. Leverage Technology

Adopting innovative technologies such as AI, IoT, robotics, sensor technologies, and machine learning can drive greater circularity and increase efficiency in material processing and product manufacturing. These technologies enable the tracking and tracing of products and components, value chain optimization, and the transformation of products into services, promoting reuse, repair, and refurbishment.

Tracing the flow of materials and products is important for the circular economy. For example, RFID is already prevalent in tracking trade consignments in India, which can also help track material flow, enabling value recovery and the implementation of reuse, repair, and remanufacture.

IoT plays a significant role in increasing efficiency throughout the entire value chain by automatically monitoring resource usage from extraction to end-of-life. IoT can also aid in the retrieval of assets for recycling, promoting the reuse of goods and reducing the extraction of biological resources from the environment. By incorporating IoT, more circularly designed products can also be developed.

Realising the importance and greater adoption of these technologies for industry in India, the Budget 2023-24 has announced setting up of 100 labs to develop 5G applications and 3 centres of excellence for Artificial Intelligence. Circular economy innovations may be identified as one of the key focus areas for fostering innovations. Technology may also be leveraged to ensure implementation and monitoring of envisaged policies for furthering circular practices such as eco-labelling, tracking of secondary raw material content in products, green public procurement etc.

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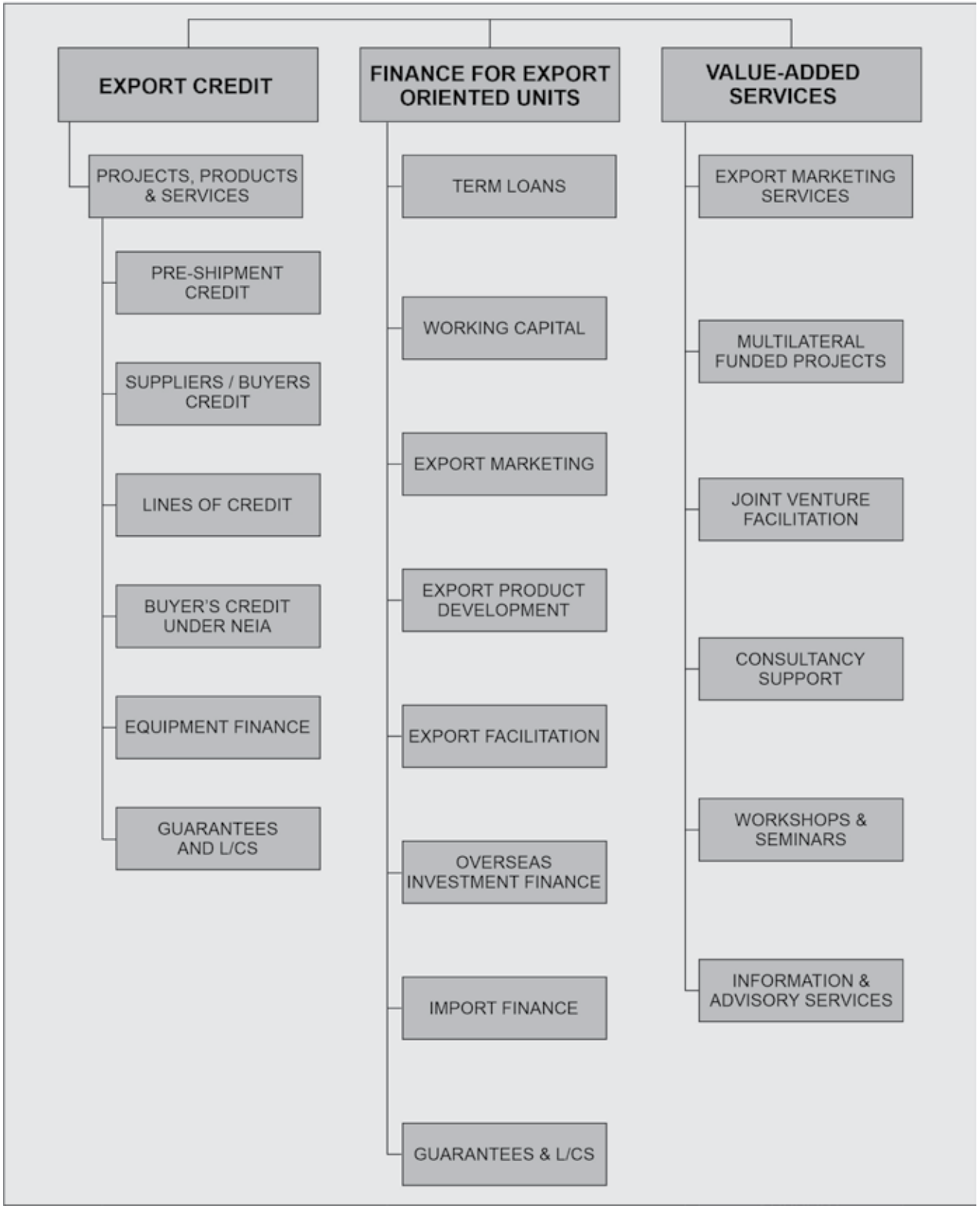

EXPORT-IMPORT BANK OF INDIA

HEAD OFFICE

Centre One Building, 21st Floor, World Trade Centre Complex, Cuffe Parade, Mumbai 400 005.
Phone: (91 22) 22172600 ● Fax : (91 22) 22182572
E-mail : ccg@eximbankindia.in ● Website: www.eximbankindia.in

LONDON BRANCH

5th Floor, 35 King Street, London EC2V 888 United Kingdom
Phone : (0044) 20 77969040 ● Fax : (0044) 20 76000936 ● E-Mail : eximlondon@eximbankindia.in

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E-mail : eximahro@eximbankindia.in

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18, M. G. Road,
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Phone : (91 80) 25585755
Fax : (91 80) 25589107
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Fax : (91 172) 4629175
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Chennai
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Fax : (91 44) 28522832
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Guwahati
NEDFi House, 4th Floor, GS Road,
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Phone : (91 361) 2237607 /609
Fax : (91 361) 2237701
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Hyderabad
Golden Edifice, 2nd Floor,
6-3-639/640, Raj Bhavan Road,
Khairatabad Circle, Hyderabad 500 004
Phone : (91 40) 23307816
Fax : (91 40) 23317843
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Kolkata
Vanijya Bhawan, 4th Floor,
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Phone : (91 33) 68261301
Fax : (91 33) 68261302
E-mail : eximkro@eximbankindia.in

Mumbai
8th Floor, Maker Chamber IV,
Nariman Point,
Mumbai 400 021
Phone : (91 22) 22861300
Fax : (91 22) 22182572
E-mail : eximmro@eximbankindia.in

New Delhi
Office Block, Tower 1, 7th Floor,
Adjacent Ring Road, Kidwai Nagar (E)
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Pune
No. 402 & 402(B), 4th floor, Signature Building,
Bhamburda, Bhandarkar Rd.,
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Phone : (91 20) 26403000
Fax : (91 20) 25648846
E-mail : eximpro@eximbankindia.in

OVERSEAS OFFICES

Abidjan
5th Floor,
Azur Building,
18-Docteur Crozet Road,
Plateau,
Abidjan,
Côte d'Ivoi re
Phone : (225) 2720242951
Fax : (225) 2720242950
Email : eximabidjan@eximbankindia.in

Addis Ababa
House No. 46,
JakRose Estate Compound,
Woreda 07,
Bole Sub-city,
Addis Ababa,
Ethiopia.
Phone : (251) 118222296
Fax : (251) 116610170
Email : aaro@eximbankindia.in

Dhaka
Madhumita Plaza, 12th Floor,
Plot No. 11, Road No. 11, Block G,
Banani, Dhaka, Bangladesh - 1213.
Phone : (88) 01708520444
E-mail : eximdhaka@eximbankindia.in

Dubai
Level 5, Tenancy IB, Gate Precinct Building No. 3,
Dubai International Financial Centre,
PO Box No. 506541, Dubai, UAE.
Phone : (971) 43637462
Fax : (971) 43637461
E-mail : eximdubai@eximbankindia.in

Johannesburg
2nd Floor, Sandton City Twin Towers East,
Sandhurst Ext. 3, Sandton 2196,
Johannesburg, South Africa.
Phone : (27) 113265103
Fax : (27) 117844511
E-mail : eximjro@eximbankindia.in

Singapore
20, Collyer Quay, #10-02,
Tung Centre, Singapore 049319.
Phone : (65) 65326464
Fax : (65) 65352131
E-mail : eximsingapore@eximbankindia.in

Washington D.C.
1750 Pennsylvania Avenue NW,
Suite 1202,
Washington D.C. 20006,
United States of America.
Phone : (1) 2022233238
Fax : (1) 2027858487
E-mail : eximwashington@eximbankindia.in

Yangon
House No. 54/A, Ground Floor,
Boyarnyunt Street, Dagon Township,
Yangon, Myanmar
Phone : (95) 1389520
E-mail : eximyangon@eximbankindia.in

Centre One Building, 21st Floor, World Trade Centre Complex, Cuffe Parade, Mumbai-400 005.

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