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From Waste to Wealth in Amrit Kaal: A Legal and Policy Analysis of India's Transition towards Environmental Sustainability and the Circular Economy through Waste Management

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Abstract

The need to adopt eco-friendly and environmental sustainable practices have advanced to become central focus in every corner of the world today. In this context, the green economy is an inclusive development model which can promote sustainable economic growth and social prosperity whilst minimizing environmental degradation. The development of industrial economy entails generation of waste, and it is so much that the environment is not able to destroy or reuse it naturally. Given this situation, the importance of waste management as its solution, is increasing day by day. Waste management refers to a broader concept that includes a series of regulations, practices, and strategies that reduce, reuse, recycle waste, and encourage responsible consumption and production. Waste from production processes can be a valuable source of secondary materials that would otherwise be land filled or incinerated, generating pollution and wasted resources. By recycling these materials from waste and reintegrating them into the materials production loops, critical raw materials can contribute to reduced environmental impacts and the promotion of circular economy. Any industry committed to reduce its carbon footprint should ultimately look to the Circular Economy. India's commitments for the transition to a circular economy are also evident in the Panchamrit announced during COP26 and the G-20 Delhi declaration.

The Amrit Kaal period, which celebrates the 75th year since India's independence, is an opportunity for the country to learn from its shortcomings and change its approach towards waste management and the environment. This paper seeks to identify the initiatives taken towards environmental sustainability and circular economy through waste management in India. The paper aims to elucidate how India can implement its waste management efforts through green technology, innovation and public-private partnerships, which will not only lead to environmental conservation, boost economic growth but also important to realise the vision of Viksit Bharat by 2047.

Introduction

Waste emerged as an urgent global issue that affects everyone. When improperly managed, it poses risk to both public health and the environment. This problem has strong ties to how we as a society consume and produce, both of which have only expanded with our ever-changing lifestyles. Waste is the by-product of many human activities, a thing we no longer want or need. Waste is of various types and can be classified in many ways: as solid, liquid, or gas depending upon

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its physical state; according to its potential for reuse or recycling; whether it is biodegradable or not; the source from which it is generated; whether it is non-harmful or hazardous/infectious; and its ability to react with an environmental medium. Waste management comprises 'systematic collection, transportation and processing of waste, along with continuous monitoring and regulatory checks from its point of generation to its final disposal. Such arrangement is very important because good waste management safeguards human health, protects the environment, conserves land and resources and helps keep the environment clean and pleasant. It is a collective responsibility that requires everyone's attention and action.

The waste management is not only a simple human need but can actually also be considered a basic human right because it plays a critical part in public health and environmental protection. The concept of 'Zero Waste' came about over the years of development in waste management practices. Zero Waste is a transition from a traditional linear "take, make, dispose" model to a circular model.[1] Zero Waste is a sustainable alternative to our present waste management practices, advocating to reduce material consumption and organic waste, recycle and reuse what we use, and to decrease the social, economic and environmental impact of our material consumption while avoiding harmful practices such as incineration and landfilling. Zero Waste aims to minimize ecological damage and mitigate climate change, conserving ecological health and the well-being of future generations. The Zero Waste International Alliance (ZWIA) defines 'Zero waste' as follows:

"The conservation of all resources by means of responsible production, consumption, reuse, and recovery of products, packaging, and materials without burning and with no discharges to land, water, or air that threaten the environment or human health."[2]

The philosophy of 'Zero waste' is built around the principle of preserving the value of materials, mitigating environmental degradation and conserving the natural resources. Zero waste can be accomplished through proper waste management practices that focus on "Reduce, reuse, and recycle."

Waste management is a key element in the transition to a green economy.[3] The Green Economy has been defined by the UN Environment Programme (UNEP) as:

"One that results in improved human well-being and social equity, while significantly reducing environmental risks and ecological scarcities."[4]

Waste management is an end-to-end process that encompasses the complete lifecycle of waste, from creation to disposal, and includes "collection, segregation, transportation, processing, recycling, treatment, and final disposal."[5] To realise the vision of Viksit Bharat by 2047, proper waste management is very essential since it deals directly with environment, public health and economy. If done properly, waste management will reduce the harmful impact of waste and help build a more sustainable and equitable green economy.

India is leaving no stone unturned to establish a circular economy but currently it faces numerous challenges at different stages in waste management.[6] The circular economy is a model of "production and consumption in which waste from one entity is utilized as a resource or raw material by another."[7] It promotes "sharing, leasing, reusing, repairing, refurbishing and recycling of existing materials

1 *Zero waste definition*. Zero Waste International Alliance. (2022, September 7). https://zwia.org/zero-waste-definition/

2 *Zero waste definition*. Zero Waste International Alliance. (2022, September 7). https://zwia.org/zero-waste-definition/

3 Misztal, P., & Dziekański, P. (2023). Green economy and waste management as determinants of modeling green capital of districts in Poland in 2010–2020. *International Journal of Environmental Research and Public Health*, *20*(3), 2112. https://doi.org/10.3390/ijerph20032112

4 United Nations Environment Programme (2011), *Towards a Green Economy: Pathways to Sustainable Development and Poverty Eradication - A Synthesis for Policy Makers*, 9 www.unep.org/greeneconomy

5 Ministry of Environment, Forest and Climate Change, Government of India. (2016). *Solid Waste Management Rules, 2016* (Rule 4(1)). Government of India.

6 Kapoor, A., & Chakma, N. (2024, March). EAC-PM Working Paper Series by Institute for Competitiveness. *EAC-PM working paper series challenges of solid waste management in urban India*. https://eacpm.gov.in/wp-content/uploads/2024/05/Solid_Waste_management_Updated.pdf

7 *Circular economy: definition, importance and benefits*. (n.d.). Topics | European Parliament. Retrieved January 9, 2026, from https://www.europarl.europa.eu/topics/en/article/20151201STO05603/circular-economy-definition-importance-and-benefits

and products."[8] Innovative technologies and eco-friendly initiatives can help India create wealth from waste. In response to these challenges, an initiative of 'Waste to Wealth' mission has been launched under the Prime Minister's Science, Technology and Innovation Advisory Council (PMSTIAC).[9] In India, the Waste to Wealth Mission has formulated Circular Economy Action Plans for ten major categories of waste.[10] This initiative includes many forms of waste, such as, "lithium-ion batteries, e-waste, tyre and rubber, plastics, industrial waste that is toxic and hazardous, scrap metal (ferrous and non-ferrous), end-of-life vehicles, gypsum, used oil, solar panels, and municipal solid waste."[11] This mission is dedicated to finding innovative ways to convert waste into energy, recycle materials, minimize waste generation, and instill sustainable practices across industries and communities, aiming to contribute to a cleaner and greener environment. Through the strategic implementation of innovative technologies and the creation of collaborative partnerships between government bodies, industries, and communities, India is committed to ushering in a circular economy where waste is effectively managed and transformed into valuable resources. This comprehensive strategy not only addresses environmental issues but also opens new avenues for economic growth and resource conserving, paving the way for a clean and sustainable future for everyone. This circular model will push us to build an effective waste management in India and simultaneously boost the Swachh Bharat Abhiyan and Smart Cities project through the application of science, technology, and accelerated waste management.[12] The circular economy promotes sustainability and zero-emissions goal. Turning waste into wealth paves the way for economic growth and leads to a cleaner planet for generations to come.

Overview on laws

The Environment Protection Act (EPA) 1986 is a key legislation to achieve sustainability through circular economy and waste management. Enacted under Article 253 of the Constitution after the Bhopal Gas Tragedy, the EPA deals to control and manage environmental pollution by providing standards and laws. It serves as the basis for the subsequent regulations such as the Solid Waste Management Rules (2016) and Plastic Waste Management Rules (2021), which incorporate the principles of the circular economy by making it mandatory to reduce waste generation, ensure waste recycling, and assign producer responsibility. The broad ambit of this act that covers air, water, and land pollution touches upon many sustainability aspects however critics have raised doubts about the enforcement and not enough focus on recycling. The EPA is one of the key instruments of policy in India's vision of a Viksit Bharat by 2047. It links environmental protection to the circular economy through mechanisms ensuring Extended Producer Responsibility (EPR) related to waste management of streams like plastics, electronic waste and tyres, which limit dependence on landfilling and resource depletion.

India's Commitment to Environmental Sustainability Vis-Vis Waste Management

Indian government has showed strong commitment towards sustainable development and environmental protection. India has become a beacon of hope to the world, ranging from ambitious targets of renewables to path-breaking initiatives to ensure economic growth while preserving the environment. Waste management is one of the cornerstones of sustainable development. India has shown action-based commitment with the

8 Ellen MacArthur Foundation (2013). *Towards the Circular Economy: An Economic and Business Rationale for an Accelerated Transition*, 1 (10). https://emf.thirdlight.com/file/24/xTyQj3oxiYNMO1xTFs9xT5LF3C/Towards%20the%20circular%20economy%20Vol%201%3A%20an%20economic%20and%20business%20rationale%20for%20an%20accelerated%20transition.pdf

9 Office of the Principal Scientific Adviser to the Government of India. *Waste to Wealth Mission*. https://www.psa.gov.in/technology-frontiers/waste-wealth-mission/1707

10 *Year end review: Ministry of environment forest and climate change*. (2022, December 12). PIB Delhi. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1886051

11 *Year end review: Ministry of environment forest and climate change*. (2022, December 12). PIB Delhi. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1886051

12 *Brief of PM-STIAC Missions*. (n.d.). Embassy of India, Tokyo. Retrieved January 9, 2026, from https://www.indembassy-tokyo.gov.in/eoityo_pages/NjQ

implementation of policies that reflect our promise to promote sustainable practices. The Swachh Bharat Mission-Urban 2.0 has prioritised sustainable solid waste management to make cities free of garbage.[13] The project also facilitates establishment of waste to energy based solutions like biomethanation plants in compliance with GOBARdhan and SATAT schemes for production of Bio-CNG (renewable energy source).[14] These projects represent the ideal formulation of circularity, turning into green energy both dry and wet fractions of municipal solid waste. Electricity and Bio-CNG generated as the by-products can be used back in sustaining the waste management operations, which are the highlights of the sustainability aspect of the project. In February 2022, asia's largest municipal solid waste based GOBARdhan plant was inaugurated at Indore.[15] This plant intended to generate 19,000 kg Bio-CNG each day, marking a significant milestone in the country's efforts to utilize waste as a potential energy source.[16] The successful implementation of such projects is expected to improve urban waste management and provide a sustainable energy source, thereby strengthening the overall goal of the mission to create cleaner and greener cities.

In various government programmes and policies, the new recycling hierarchy expands the 3R's (Reduce, Reuse, Recycle) to 5R's. The 5R's refers to "refuse, reduce, reuse, repurpose and recycle.[17] The 5R approach serves as a guideline for effective waste management and sustainable lifestyle. The 5 R's outline four actions: refuse, reduce, reuse, repurpose, and recycle, that should be taken before 'recycling'. Adopting this approach across every household or business can reduce waste generation, landfill disposal and promote recycling efforts. The Government has been continuously formulating policies and promoting projects under Swacch Bharat Abhiyaan to take the country forward for a circular economy. To streamline the objectives, Ministry of Environment, Forest, and Climate Change (MoEFCC) has already notified some rules and directions viz. the Plastic Waste Management Rules, e-Waste Management Rules, Construction and Demolition Waste Management Rules, Metals Recycling Policy, etc. NITI Aayog also launched various initiatives aimed at sustaining economic growth. Direct approaches were explored in order to address the issues of waste to resource in a circular economy and created a comprehensive strategy for the recycling sector in India. The collaboration with the private sector, civil society, and non-governmental organizations enhances efficiency in service delivery, better practice, and improved accountability of service providers. It also provides more support to the informal waste picker community, who play an important role in collecting and reclaiming recyclable and reusable material.

Amrit Kaal for India

Sustainable growth is the key to an aatmanirbhar Bharat in the Amrit Kaal. With the rise of the Swachh Bharat Abhiyan movement, India discovered its way of having a cleaner, sustainable future. With India's affirmation to the Paris Accord, there need to tranform the oportunities in waste management to develop clean energy and economic growth.[18] Therefore, we need a model of development that promotes optimum resource utilization leading to climate resilience and sustainability. Such a solution adheres to the principles of circular economy; minimizing discards, reusing, and recycling resources into a circular continuum. With a rising

13 Asian Development Bank. (n.d.). *India: Swachh Bharat Mission 2.0–Comprehensive Municipal Waste Management in Indian Cities Program*. Adb.org. Retrieved January 9, 2026, from https://www.adb.org/sites/default/files/project-documents/56286/56286-001-rrp-en.pdf

14 *Waste to Energy Programme.* (n.d.). Ministry of New and Renewable Energy, Government of India. Retrieved January 9, 2026, from https://mnre.gov.in/en/waste-to-energy/

15 Indore's GOBARdhan Plant Transforms Waste, Cuts Emissions, & Boosts Economy. (n.d.). *Transforming waste into wealth with Asia's largest bio-CNG plant*. PIB Delhi. Retrieved January 9, 2026, from https://pib.gov.in/PressNoteDetails.aspx?NoteId=152161&ModuleId=3&reg=3&lang=1

16 Indore's GOBARdhan Plant Transforms Waste, Cuts Emissions, & Boosts Economy. (n.d.). *Transforming waste into wealth with Asia's largest bio-CNG plant*. PIB Delhi. Retrieved January 9, 2026, from https://pib.gov.in/PressNoteDetails.aspx?NoteId=152161&ModuleId=3&reg=3&lang=1

17 Skjeie, L. (2021, June 4). *The five Rs: Refuse, reduce, reuse, recycle, rot*. San Jose Recycles. https://sanjoserecycles.org/the-five-rs-refuse-reduce-reuse-recycle-rot/

18 Shwetha, T., & siliconindia. (n.d.). *Waste to wealth: Innovation in E-waste Ecosystem*. Siliconindia. Retrieved January 10, 2026, from https://www.siliconindia.com/news/general/waste-to-wealth--innovation-in-ewaste-ecosystem-nid-219778-cid-1.html

population, rapid urbanization, climate change and environmental pollution, the country needs to adopt a circular economy. Adopting a circular economy aims to keep resources in use as long as possible and to recycle them continuously into the production process, offering a path toward resilience and sustainability. This circular model has one of its best implementations in wastewater treatment plants, where water can be recycled through household waste into water used on agriculture, energy and fertilizers, thus meaning these systems focus a lot in having no environmental impact. Moreover, it includes the recovery of materials and minerals, reducing our reliance on new raw materials and the economic and ecological costs of reprocessing. Transitioning from linear to a circular economy can reduce emissions by consuming less resources and increasing efficiency. Recycling and reusing materials can save energy and water, as well as create profitable supply chains.[19] This reduces waste, turning it into valuable resources through the recovery of materials and equipment for production, from raw materials to spare parts and reengineered components. The rules under government policies, such as Extended Producer Responsibility and E-Waste management have also significantly contributed to a cleaner and greener environment.[20] These comprehensive policies and rules are paving a way towards a stronger, self-reliant India during the time of Amrit Kaal.

The budget for FY2025-26 looks to be a major milestone for the green growth and green technology sectors, as India marches towards a target of net-zero carbon emission by 2070.[21] Transitioning to a circular economy is necessary to meet the greenhouse gas emission reduction targets affirmed during Paris pact and fulfill its commitments towards responsible consumption a nd production outlined in the Sustainable Development Goals. Research shows that Circular Economy in India holds the promise of an annual benefit of USD 624 billion by 2050, and the potential to reduce greenhouse gas emissions by 44%, providing a much-needed pathway in mitigating the impact of climate change.[22] Adoption of systematic approach towards recycling of end-of-life electronic equipment, batteries, tires & plastic waste will be require to transition from linear to circular economy minimizing the impact to environment and promoting sustainable development. Effective collaboration between the government, industry, and technology is essential to convert waste management from a challenge into an opportunity for both economic and environmental advancement. Technological innovations can help transform waste into valuable resources, and drive a circular economy. The last Union Budget of 2023-24 laid out the seven priorities or 'Saptarishi' that will guide us in the Amrit Kaal.[23] Green Growth is one of the seven Saptarishi goals in that Budget.[24] This transformative initiative will take the country towards the 'Amrit Kaal' vision and be the guiding document for the creating a strong and inclusive economy. Under budget, 500 new Waste to Wealth plants announced to be set up under GOBARdhan scheme to encourage circular economy.[25] The budget also reflects the government sense of action in supporting Circular Economy through bio-CNG intervention. The government has also been actively promoting bio-CNG production under the Sustainable Alternatives towards Automobile

19 İncekara, M. (2022). Determinants of process reengineering and waste management as resource efficiency practices and their impact on production cost performance of Small and Medium Enterprises in the manufacturing sector. *Journal of Cleaner Production, Elsevier*, *356*(131712), 131712. https://doi.org/10.1016/j.jclepro.2022.131712

20 Chauhan, N. (2023, October 12). *Multi-pronged approach needed to solve India's growing e-waste problem*. Down To Earth. https://www.downtoearth.org.in/blog/waste/multi-pronged-approach-needed-to-solve-india-s-growing-e-waste-problem-92265

21 Renewable Watch Magazine. (2016, June 20). *Union Budget 2025-26: What India's green industry expects from the upcoming budget*. Renewable Watch. https://www.renewablewatch.in/

22 Shankar Prasad Sarma, Shalini Goyal Bhalla, et.al. (2023, April). *India's Tryst with a Circular Economy, Economic Advisory Council to the Prime Minister (EAC-PM)*. EAC-PM Working Paper Series. https://eacpm.gov.in/wp-content/uploads/2023/07/17-Indias-Tryst-with-a-Circular-Economy.pdf

23 *Budget 2023-24 presents vision for Amrit kaal- blue print for an empowered and inclusive economy*. (2023, February 1). PIB Delhi. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1895313

24 *Budget 2023-24 presents vision for Amrit kaal- blue print for an empowered and inclusive economy*. (2023, February 1). PIB Delhi. https://pib.gov.in/PressReleaseIframePage.aspx?PRID=1895313

25 *MoHUA signs MoU to develop Waste to Wealth plants in million plus cities*. (2023, February 2). PIB Delhi. https://pib.gov.in/PressReleasePage.aspx?PRID=1895790

Transportation (SATAT) scheme.[26] Some of the projects that are implemented also use agricultural waste (primarily rice straw from Punjab and Haryana) and waste generated by the cities to produce Bio-CNG. This renewable bio-CNG then used as alternative fuels in vehicles such as city buses, contributing to sustainable urban transportation solutions. Furthermore, bio-CNG plants provide a paradigm shift in managing solid waste in rapidly urbanising cities. The Waste-to-Wealth Mission that is based on the Circular Economy model opens many avenues for business and new jobs. The mission promotes entrepreneurship in areas such as waste management as it sets out to turn waste into a resource by implementing recycling and upcycling projects. This mission plays a crucial role in ensuring sustainable development and economic growth. Integrating the informal sector is critical to this transformation. The waste pickers or collectors and recyclers, who often operate outside of formal system, handle about 98 percent of all recyclables in the country. Formalisation of these workers by providing them training (both technical and managerial), access to technology and inclusion in waste management supply chains will not only empower them but also lead to better waste management efficiencies and better livelihoods for them by providing a stable source of income as well as social benefits. The Waste-to-Wealth Mission not only taps into the abundant resources of waste but also creates new industries, businesses, and local employment opportunities in communities, and sustainable consumption of resources through environmental responsibility, aligned with local business opportunities in reducing waste. By addressing environmental concerns and promoting economic development in an inclusive way this collective endeavor finds the pathway for a better and more resilient future.

Government Policies and Initiatives in Amrit Kaal

The solid waste management sector in India has made significant strides mainly due to the focus on cleanliness and sanitation by the Government. With increasing population and rapid urbanisation, the output of waste is higher than it has ever been and the need for sustainable and efficient waste management becomes paramount. To facilitate the implementation of the Aatmanirbhar Bharat Abhiyaan, a mission towards a self-reliant India and AMRUT, the scheme to help cities become more livable, the government has taken bold action to transform our economy from a wasteful linear economy to a resource smart circular economy. After stakeholder consultations, NITI Aayog has identified eleven priority sectors that will catalyse the shift to sustainable waste management. These are municipal solid and liquid waste, scrap metal, lithium-ion batteries, tyres, gypsum, end-of-life vehicles, e-waste, industrial hazardous waste, used oil, agricultural waste and solar panels.[27] To put this vision into action, the government finalized detailed plans incorporating regulations and development projects in 10 such key sectors by March 2022.[28] These action plans are designed to tackle waste at the source while encouraging economic growth via recycling and life cycle continuity. Subsequently, in September 2022, NITI Aayog established the 'Circular Economy Cell' as a dedicated unit to drive this mission to next level with focused energy.[29] The Circular Economy Cell serves as an important strategic driver for a transition towards a circular economy and environmental sustainability. This dedicated unit ensures that policies stay on track, connecting short term waste management solutions to long term objectives of fulfilling a sustainable self-reliant and Viksit Bharat by 2047.

The Circular economy is a model that designed to reduce waste and to ensure the continuous use of resources by adopting the closed loop production process through sharing, leasing, reusing, repairing, refurbishing and recycling existing materials and

26 Ministry of Petroleum and Natural Gas, Government of India. (2018). *Sustainable alternatives towards affordable transportation (SATAT).* Government of India.

27 *NITI Aayog, Annual Report 2022-2023*. (n.d.). Retrieved January 10, 2026, from https://www.niti.gov.in/sites/default/files/2023-02/Annual-Report-2022-2023-English_1.pdf

28 Niti Aayog, India. (n.d.). *Circular Economy Cell (CE Cell),NITI Aayog*. Gov.In. Retrieved January 10, 2026, from https://www.niti.gov.in/circular-economy-cell

29 Niti Aayog, India. (n.d.). *Circular Economy Cell (CE Cell),NITI Aayog*. Gov.In. Retrieved January 10, 2026, from https://www.niti.gov.in/circular-economy-cell

products.[30] In this model, waste of all sorts like, old clothes, scrap metal or outdated electronics is either reincorporated into the economy or utilized more efficiently, reducing the wastefulness of the economy. Following these processes, it reduces emissions because fewer resources are used, less waste is generated and how the materials are processed is optimized. The circular model reduces emissions by consuming fewer resources, creating less waste, and increasing efficiency in material use. In addition it reduces pollution, encouraging recycling, reuse, and repurposing between industries, creates new economic opportunities and lessens pressure on environment. By promoting recycling, reuse, and repurposing across industries, this approach not only curbs pollution but also opens up new economic possibilities and reduces strain on nature. It also encourages businesses to consider changing their practices by adopting eco-friendly designs, increasing product longevity and adopting policies like Extended Producer Responsibility (EPR) to reduce their environmental impact while still making a profit. The OECD framework on EPR is a global reference and provides momentum to India's comprehensive frameworks moving towards a circular economy. The introduction OECD guildines in 2001, titled "Extended Producer Responsibility: A Guidance Manual for Governments," the OECD proposed to hold producers responsible for the management of their products at the end of their lives, and promotes eco-design and increases recycling. India has adopted the OECD guidelines on the principle of Extended Producer Responsibility (EPR) in its statutory laws and regulations concerning the waste disposal of plastics, e-waste, batteries, and tyres.

Extended Producer Responsibility (EPR) is a globally recognized environmental policy framework that obligates producers responsible for the entire life cycle of their products, including the proper management and treatment of waste generated after consumer's use. It shifts the responsibility for collecting, recycling, and disposing of products from consumers and governments to the manufacturers, encouraging them to produce sustainable goods and ensure that whatever they produce is reused or safely managed. The EPR concept is grounded on the "polluter pays" principle, aims to minimize environmental damage, promote resource efficiency, and support a circular economy by ensuring that materials remain in use instead of being disposed of. It applies to various generated wastes like packaging, electronics, batteries, and tyres. It aims at creating sustainable production and consumption on a global scale.[31]

India has paved the way to build a circular economy with Extended Producer Responsibility (EPR) woven into national laws, establishing achievable targets. In short, EPR makes companies responsible for the waste of their product, aiming to cut down waste generated from consumer ends, create greener materials, partner with local governments for waste collection, and build new ways to keep resources cycling in the economy. It's about turning waste into something useful instead of letting it pile up. To realise this, the government has implemented regulations that are based on the market-based EPR concept, targeting four big waste types: Tyres, plastic packaging, batteries, and electronics.

Waste Tyre Management Rules, 2022[32]

India generates around 275,000 tyres a year but no guidelines exist on managing disposal.[33]Another three million scrap/used tyres are reimported for reprocessing. With growing emphasis on environmental sustainability, managing tyre waste has emerged as a serious global challenge. Used

30 Kirchherr, J., Yang, N.-H. N., Schulze-Spüntrup, F., Heerink, M. J., & Hartley, K. (2023). Conceptualizing the circular economy (revisited): An analysis of 221 definitions. *Resources, Conservation, and Recycling, Elsevier*, *194*. https://doi.org/10.1016/j.resconrec.2023.107001

31 Integrate Extended Producer Responsibility within the International Plastics Treaty: Common Position Paper (November 2022). United Nations Environment Programme. https://apps1.unep.org/resolutions/uploads/integrate_epr_within_the_international_treaty_on_plastics_pollution_1.pdf

32 Government of India. (2022). *The Hazardous and Other Wastes (Management & Transboundary Movement) Amendment Rules, 2022: GSR 593(E) – provisions relating to scientific and environmentally sound management of waste tyres*.

33 *Environment Ministry brings out draft EPR notification for waste tyres*. (2022, January 6). The Economic Times. https://auto.economictimes.indiatimes.com/news/tyres/environment-ministry-brings-out-draft-epr-notification-for-waste-tyres/88724141

tyres accumulation and disposal may greatly harm ecosystems and human health. However, to tackle such challenges, Extended Producer Responsibility (EPR) registration for tyre waste management has been one of the important strategies to reduce the ecological footprint of disposed tyres..[34] Ministry of Environment, Forests and Climate Change notified the Hazardous and Other Wastes Amendment Rules, 2022 for EPR of Tyre wastes. The rules aim to delineate the responsibilities of producers, recyclers, retreaders in handling waste tyres starting from their collection, transportation, storage recycling, reuse and disposal. The amended rules has come into effect from July 21, 2022, provides for the duties of such entities to manage and dispose of waste tyres in an eco-friendly manner. Through the amendment, a new Schedule IX has been introduced providing for the EPR regime for waste tyres, specifying the liabilites of producers, recyclers and retreaders to comply with eco-friendly disposal and management. Rule 1 (d)[35] defines,'extended producer responsibility' as the "responsibility of producer of tyre to ensure environmentally sound management of waste tyre in accordance with the provisions of this Schedule." Rule 1 (c),[36] defines 'environmentally sound management of waste tyre' as "taking all steps required to ensure that waste tyre is managed in a manner so as to protect health and environment against any adverse effects which may result from such waste tyre." As per Rule 10, producers and recyclers who fail to adhere to the requirements outlined in the newly introduced schedule will be obligated to pay environmental compensation, the amount of which will be calculated based on guidelines established by the Central Pollution Control Board (CPCB).

The Waste Tyre Management Rules, 2022, emphasize accountability and sustainability in handling tyre waste. By mandating environmental compensation for non-compliance, the rules aim to deter irresponsible disposal practices and promote adherence to eco-friendly recycling standards. The CPCB role in enforcing penalties underscores the framework's focus on regulatory rigor and environmental protection. These provisions mark a significant step toward reducing pollution from tyre waste, encouraging innovation in recycling, and fostering a circular economy in the automotive and industrial sectors.

Plastic Waste Management Rules, 2016[37]

Due to its properties, plastic has become one of the most widely used products in our daily life. Ironically, its same properties have led it to become one of the most dangerous materials to the environment. The government has established clear laws to reduce plastic pollution. One of those initiatives is "Extended Producer Responsibility (EPR)", a policy that legally requires certain stakeholders to ensure the environmentally sound disposal or management of plastic waste. The government released a notification, amending the existing rules for the management of plastic waste. The amendment introduced Schedule II, specifying Extended Producer Responsibility (EPR) guidelines for plastic packaging. The amended Plastic Waste Management Rules, 2016 provide the regulatory framework for the environmentally safe management and disposal of plastic waste, including single-use plastic. The EPR Guidelines for plastic packaging waste are provided under the Plastic Waste Management (Amendment) Rules, 2022 (notified on February 16, 2022). The EPR Guidelines mandate specific targets for plastic packaging waste recycling, reuse of rigid plastic packaging, and incorporation of recycled plastic content. These rules created a formal structure to establish a circular economy for plastic waste, promote alternatives to traditional plastics and incentivize businesses on transitioning

34 Government of India. (2022). *Schedule IX: Extended producer responsibility (EPR) for waste tyre*, under *The Hazardous and Other Wastes (Management & Transboundary Movement) Amendment Rules, 2022*. Ministry of Environment, Forest and Climate Change.

35 Government of India. (2022). *Hazardous and Other Wastes (Management and Transboundary Movement) Amendment Rules, 2022* (Rule 1(d), Schedule IX: Extended producer responsibility (EPR) for waste tyre). Ministry of Environment, Forest and Climate Change.

36 *Hazardous and Other Wastes (Management and Transboundary Movement) Amendment Rules, 2022* (Rule 1(c), Schedule IX: Extended producer responsibility (EPR) for waste tyre). Ministry of Environment, Forest and Climate Change (2022)

37 *The Plastic Waste Management Rules, 2016* (G.S.R. 320(E)). Ministry of Environment, Forest and Climate Change, Government of India.

to sustainable packaging. It has made the reuse of rigid plastic packaging to minimize the production of new plastic materials. These rules aim to reduce plastic consumption and improve the recycling efficiency by imposing minimum recycling quotas on plastic waste collected under EPR and increasing the usage of recycled plastics. The EPR guidelines[38] will set an example for the formalization & further improvement of plastic waste management sector. EPR guidelines for plastic packaging support the sustainability mindset, which promotes conscious living and the allocation of sustainable, recyclable, and viable plastic packaging materials, ultimately resulting in a smaller plastic footprint for every human on Earth.

The rules also provides a mechanism for trading surplus Extended Producer Responsibility (EPR) certificates, paving the way for a market-based solution to the plastic waste.[39] It encourages the transition towards sustainable plastic packaging and minimizes the environmental impact of such materials. In cases of non-compliance with these rules, violators are liable to pay fines, termed environmental compensation. The fine collected shall be used for collection, recycling and disposal of plastic waste in an environmentally sound manner. Last year, the Plastic Waste Management (Amendment) Rules, 2024, introduced ban on microplastics, and laid down more stringent criteria for biodegradable plastics.[40] The new rules have expanded the definition of importer, manufacturer, producer, seller making them more responsible and liable to discharge Extended Producer Responsibility in accordance with the guidelines provided in Schedule- II. The implementation of Extended Producer Responsibility (EPR) on plastic packaging is very important to manage plastic waste in the country. EPR enables a circular economy for plastic packaging, promotes sustainable alternatives to plastics and supports innovative business models

Battery Waste Management Rules, 2022

On 22 Aug., 2022, the Ministry of Environment, Forest and Climate Change, notified the Battery Waste Management (BWM) Rules, 2022[41]. Rule 2[42] extends its applicability to all types of batteries viz. Electric Vehicle batteries, portable batteries, automotive batteries and industrial batteries irrespective of chemical nature, shape, size, weight or use.[43] The rules are based on the principle of Extended Producer Responsibility (EPR). According to the Rules 4(1),[44] producer (manufacturers, importers) shall be liable for Extended Producer Responsibility for the battery sold in the market. The producer shall achieve the collection & recycling targets as specified in Schedule II of the Rules, to comply with the Extended Producer Responsibility obligations. Rule 4 (3),[45] expressly prohibits disposal of waste batteries through landfills and incineration, and ensures that waste batteries shall be collected and sent for recycling/refurbishment. Under Rule 4(10), producers can register themselves to meet their EPR obligations, or authorize another entity to collect, recycle or refurbish waste batteries on their behalf.[46] The rules provide for setting up a central e-portal for exchange of EPR certificates between the producers and recyclers/refurbishers, so that producers can fulfill their obligations. It promotes setting up of new industries and entrepreneurship in collection and recycling/refurbishment of waste batteries. The rules prescribe minimum material recovery percentage from waste batteries which in turn encourage development of new technologies and investment in the recycling and refurbishment industry and would create new business opportunities.

The rules set a target of 90% recovery of the battery material of which, 70 per cent to be achieved by 2024-25, 80 per cent by 2026, and 90 per cent after 2026-27 onwards."[47] Reduced dependence on

38 Guidelines for Assessment of Environment Compensation to be levied for Violation of Plastic Waste Management Rules, 2016(as amended). https://cpcb.nic.in/uploads/plasticwaste/EC_Regime_PWM_04-04-2024.pdf
39 Plastic Waste Management Rules, 2016, Rule 8.
40 The Plastic Waste Management (Amendment) Rules 2024, Rule 2(1).
41 Battery Waste Management Rules, 2022 were notified by MoEF&CC on 22 August 2022 in supersession of the Batteries (Management and Handling) Rules, 2001.
42 Battery Waste Management Rules, 2022, Rule 2 (1) i, ii.
43 Battery Waste Management Rules, 2022, Rule 2 (1) i, ii.
44 Battery Waste Management Rules, 2022, Rules 4(1).
45 Battery Waste Management Rules, 2022, Rule 4 (3).
46 Battery Waste Management Rules, 2022, Rule 4 (10).
47 Battery Waste Management Rules, 2022, Schedule II.

new raw materials can be achieved by prescribing usage of certain percentage of recycled materials for the production of new batteries. Rule 13 based on the principle of Pollution Pays Principle, provides for imposition of Environmental compensation if the targets of Extended Producer Responsibility and obligations laid down in the rules are not fulfilled.[48]. The fund raised as environmental compensation will be used to ensure that uncollected and non-recycled waste batteries are collected and then recycled or refurbished.

The Battery Waste Management (Amendment) Rules, 2024, introduced last year, brought important changes to the existing battery waste management rules (Battery Waste Management Rules, 2022). It has improved the regulatory landscape around battery waste management and circular economy. The amendment included penalties for non-compliance. This provision was also there in the 2022 Rules but remained ambiguously defined. Rule 13(3) now requires the Central Pollution Control Board (CPCB) to prepare and publish legally binding guidelines to recover penalty for violations by producers, recyclers and refurbishers. The EPR targets not being met by producers or producers not complying with this obligation have to pay fines or or the cancellation of their authorization. While, the 2022 Rules depended on self-reporting, and thus, leaving a scope for fraud with regard to reporting as well as monitoring. The amendment has made it mandatory to submit real-time data on centralised portal, thus leaving no room for duplication or fraud. This builds public trust in waste management processes and promotes compliance in the supply chain. This amendment also regarded as huge step towards inclusivity because it introduces provisions to include informal waste workers into the formal recycling networks, with training and financial incentives that were missing in the 2022 framework.

E-Waste (Management) Rules, 2022

The government has taken several regulatory measures to tighten its grip over the e-waste recycling industry. In November, 2022 the Ministry of Environment and Forests (MoEF) has amended and notified the E-Waste (Management) Rules, 2016 as E-Waste (Management) Rules, 2022 which came into force w.e.f 1st April, 2023. The amended rules expand the scope of regulation to include all parties vis, manufacturers, producers, refurbishers, dismantlers and recyclers, involved in the life cycle of Electrical and Electronic Equipment (EEE) of over 100 listed items such as solar photovoltaic modules; tablets; modems; GPS devices; and electronic storage systems. The amended rules provide more robust EPR framework, which requires producers, manufacturers, refurbishers and recyclers to set annual recycling targets thereby holding them accountable for waste generated by them.[49] Moreover, these provisions intend to formalize informal sector operations by integrating kabadwala (waste pickers, scrap dealers) into regulated recycling business, which are incentivized to adopt sustainable practices towards e-wastes.[50]

The additional provisions have also been introduced related with Environmental Compensation, Verification and Audit. The Rule promotes Circular Economy through robust comprehensive EPR framework and scientific recycling/disposal of the e-waste.[51] If the electrical and electronic equipment at their end-of-life stage are managed and treated scientifically do not cause any harm to health and environment.[52] However, unscientific retrieval of useful components or disposal of any material can lead to serious health hazards and environmental contamination. The E-Waste Management Rules also provides the reduction of hazardous substances in Electrical and Electronic Equipment (EEE) at the manufacturing stage. Rule 16[53] requires every producer of EEE and its components to ensure that its products do not contain lead, mercury and other hazardous substances more than the maximum prescribed limit. While these rules intended to limit hazardous e-waste, but long-term sustainability will depend on product designs friendly to repair and recycling. The notification of the E-Waste (Management) Second

48 Battery Waste Management Rules, 2022, Rule 13.

49 E-Waste (Management) Rules, 2022. *Responsibities*, Chapter 3.
50 E-Waste (Management) Rules, 2022, Rule 3(c).
51 E-Waste (Management) Rules, 2022, Rule 2.
52 E-Waste (Management) Rules, 2022, Rule 3(i).
53 E-Waste (Management) Rules, 2022, Rule 16.

Amendment Rules, 2023 supplements previous directives to build a closed-loop system for the management of refrigerants that come out during the manufacturing and end-of-life of refrigeration and air-conditioning equipment. On 8th March, 2024, The E-Waste (Management) Amendment Rules, 2024 have been issued by the government further amending E-Waste (Management) Rules, 2022. The E-Waste (Management) Rules also include provisions for recognition and registration, skill development initiatives, monitoring mechanisms, and health and safety measures for workers engaged in dismantling and recycling of e-waste.[54]

Conclusion

The Solid Waste Management Market in India is likely to grow due to several factors such as rising urbanisation, growing waste management awareness. This sector also attracted investments in waste management infrastructure and technologies primarily driven by government initiatives like the Swachh Bharat Mission. An effective waste management system will recycle waste into reusable raw materials, thereby lowering the dependence for new resources to be extracted from the earth. The Solid Waste Management sector generates jobs and also promotes innovation in advanced waste management technologies. It moreover plays an important role in the reduction of greenhouse gas emissions associated with waste, providing solid support for global climate change mitigation initiatives.

The circular economy is a strategic economic model aimed at eliminating waste and encouraging continuous resource use, is truly a paradigm shift that requires a comprehensive view of entire lifecycles and systems. To make this vision come true, we need industrial ecosystems to embrace circular principles as part of their very business models, not only to reduce dependence on ever scarcer resources, but also to leverage innovation-driven operational efficiency to increase competitiveness at the global scale. Ultimately, we can find a balance in which industries focus on the redesign of material flows within value chains: design and production, consumption and recovery, enabling closed-loop systems that regenerate natural capital. Aligning economic activities with principles of circularity offers a sustainable pathway that provides mutual benefits. By decoupling economic growth from resource extraction, it fosters systems where products and materials are maintained in use cycles, creating value through innovation rather than consumption. It enables multiple benefits in terms of economic resilience, supporting ecological restoration, and enhancing overall social well-being. India could realise significant benefits from a circular economy path, including a substantial reduction in pollution, and positive economic impacts. Depending on how efficiently we could utilize resources, avoid overconsumption of finite resources and venture new sustainable business models, the Amrit Kaal phase could leapfrog towards self-reliance and set a strong foundation "Viksit Bharat".

54 E-Waste (Management) Rules, 2022, Rule 10.

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