Law Audience Journal, Volume 5 & Issue 6, 30th Jan 2025, e-ISSN: 2581-6705, Indexed Journal, Impact Factor 5.611, Published at https://www.lawaudience.com/volume-5-issue-6-2/, Pages: 210 to 222,

Title: E-Waste Management, Authored By: Ms. Vaishnavi Deshpande, B.B.A.LL.B. (Hons.), SVKM's NMIMS, Indore (M.P.), Email Id: vaishnavideshpande222@gmail.com.

Cite this article as:

MS. VAISHNAVI DESHPANDE, *"E-Waste Management" Vol.5 & Issue 6, Law Audience Journal (e-ISSN: 2581-6705), Pages 210 to 222 (30th Jan 2025), available at https://www.lawaudience.com/e-waste-management/.*

Law Audience Journal, Volume 5 & Issue 6, 30th Jan 2025, e-ISSN: 2581-6705, Indexed Journal, Impact Factor 5.611, Published at https://www.lawaudience.com/volume-5-issue-6-2/, Pages: 210 to 222,

Title: E-Waste Management, Authored By: Ms. Vaishnavi Deshpande, B.B.A.LL.B. (Hons.), SVKM's NMIMS, Indore (M.P.), Email Id: vaishnavideshpande222@gmail.com.

Law Audience Journal, Volume 5 & Issue 6, 30th Jan 2025, e-ISSN: 2581-6705, Indexed Journal, Impact Factor 5.611, Published at https://www.lawaudience.com/volume-5-issue-6-2/, Pages: 210 to 222,

Title: E-Waste Management, Authored By: Ms. Vaishnavi Deshpande, B.B.A.LL.B. (Hons.), SVKM's NMIMS, Indore (M.P.), Email Id: vaishnavideshpande222@gmail.com.

Disclaimer:

Law Audience Journal, Volume 5 & Issue 6, 30th Jan 2025, e-ISSN: 2581-6705, Indexed Journal, Impact Factor 5.611, Published at https://www.lawaudience.com/volume-5-issue-6-2/, Pages: 210 to 222,

Title: E-Waste Management, Authored By: Ms. Vaishnavi Deshpande, B.B.A.LL.B. (Hons.), SVKM's NMIMS, Indore (M.P.), Email Id: vaishnavideshpande222@gmail.com.

Publisher Details:

Law Audience Journal (e-ISSN: 2581-6705),

Sole Proprietorship of Mr. Varun Kumar, Kharar, District. S.A.S, Nagar, Mohali, 140301,

Phone No(s): +91-8351033361 (WhatsApp),

Email ID(s): lawjournal@lawaudience.com, info@lawaudience.com or lawaudience@gmail.com.

Website: www.lawaudience.com.

Contact Timings: 10:00 AM to 8:00 PM.

Editor(s):

Law Audience Journal, Volume 5 & Issue 6, 30th Jan 2025, e-ISSN: 2581-6705, Indexed Journal, Impact Factor 5.611, Published at https://www.lawaudience.com/volume-5-issue-6-2/, Pages: 210 to 222,

Title: E-Waste Management, Authored By: Ms. Vaishnavi Deshpande, B.B.A.LL.B. (Hons.), SVKM's NMIMS, Indore (M.P.), Email Id: vaishnavideshpande222@gmail.com.

I. INTRODUCTION:

E-waste emerged as a crucial environmental and health risk in the 21st century. E-waste generated by the growing speed of the diffusion of technologies and the demands of consumers toward electronic devices resulted in an exponentially high growth rate throughout the world. E-waste, or discarded electronic devices, largely consists of computer products, information and communication technology equipment, home appliances, audio and video apparatus, and related accessories. While there is no broad consensus, e-waste together covers very expensive and durable goods used to process data or operate telecommunications and entertainment equipment in homes and companies.[1]

E-waste is not inherently hazardous provided it's stored safely, recycled using scientific methods, or transported within the formal sector. However, it becomes hazardous when recycled using primitive methods popular in the informal sector. Heavy metals (such as lead, cadmium, and mercury), plastics, and glass are all components of e-waste, and if not treated properly, they can be detrimental to the environment and human health.

E-waste contains dangerous and poisonous compounds such as:

- **Lead (Pb):** Mainly contained in all types of electronic products/assemblies, CRTs, among others.
- **Cadmium (Cd):** Available in monitor/CRTs and computer batteries. This also has plating metal enclosures/parts.
- **Mercury (Hg):** Available in switches, flat screen monitors, CFLs, relays, and other particular products.
- **Polychlorinated biphenyls (PCBs):** These can be found in capacitors and transformers.
- **Brominated flame retardants:** Printed circuit boards, plastic casings, cables, and polyvinyl chloride (PVC) cable sheathing use this.[2]

[1] Dr. S. Chatterjee, *Electronic Waste and* India, Department of Information Technology
[2] *id* 1

Law Audience Journal, Volume 5 & Issue 6, 30th Jan 2025, e-ISSN: 2581-6705, Indexed Journal, Impact Factor 5.611, Published at https://www.lawaudience.com/volume-5-issue-6-2/, Pages: 210 to 222,

Title: E-Waste Management, Authored By: Ms. Vaishnavi Deshpande, B.B.A.LL.B. (Hons.), SVKM's NMIMS, Indore (M.P.), Email Id: vaishnavideshpande222@gmail.com.

Improper e-waste recycling, especially in the informal sector using primitive methods such as open burning and acid leaching, can seriously harm the environment.

The harmful effects of e-waste can occur in the following ways:

- **Soil Contamination:** Leaching of hazardous contents from landfills contaminates the soil.
- **Water Contamination:** Rivers, wells, and other water sources get contaminated due to improper disposal and leaching.
- **Air Pollution:** The toxic gases and particulate matter generated from burning e-waste cause air pollution.

Health Hazards associated with improper recycling processes include

- **Exposure to Inhale Toxic Fumes:** Exposure to gas generated from burning or chemical treatment.
- **Skin Exposure:** Direct contact with hazardous chemical through naked skin.
- **Acid Treatment Exposure:** Contact with hazardous chemical during the recovery of metals through acid.

India is one of the major consumers of electronics and has faced considerable challenges in sustainable e-waste management. As the world's third-largest e-waste generation, India's management challenges stem from limited infrastructure, poor regulatory enforcement, and the dominance of the informal recycling sector. This article examines India's e-waste management landscape, including the legislative framework, enforcement mechanisms, best practices from across the world, and ongoing government initiatives.[3]

II. WASTE GENERATION IN INDIA:

India stands at the third place in the global chart of e-waste generation[4]. China and the United States take the first and second places. In India, e-waste volume has increased phenomenally, standing at 1.751 million metric tons (MT) in the period of 2023-24, which shows an increase

[3]Dr. S. Chatterjee, *Electronic Waste and* India, Department of Information Technology
[4] Global E-Waste Monitor 2023, United Nations University circular

Law Audience Journal, Volume 5 & Issue 6, 30th Jan 2025, e-ISSN: 2581-6705, Indexed Journal, Impact Factor 5.611, Published at https://www.lawaudience.com/volume-5-issue-6-2/, Pages: 210 to 222,

Title: E-Waste Management, Authored By: Ms. Vaishnavi Deshpande, B.B.A.LL.B. (Hons.), SVKM's NMIMS, Indore (M.P.), Email Id: vaishnavideshpande222@gmail.com.

of 72.54% from that of 2019-20.[5] The 65 cities of India contribute to over 60% of the total e-waste, while the 10 states contribute to about 70%. This is a huge 31% rise compared to 2019. Examples of largest contributors to e-waste generation include discarded mobile phones, laptops, televisions, air conditioners, and other electronic appliances. The accelerated pace of urbanization, digitalization, and higher disposable income has led to this rapid growth.[6]

II.I KEY DATA ON E-WASTE IN INDIA:

- **Household Electronics:** Mobile phones and personal computers make up more than 60% of India's e-waste.
- **Informal Recycling Sector:** More than 90% of e-waste is recycled in the informal sector, which generally uses primitive and unsafe methods.
- **Per Capita Generation:** The per capita e-waste generation in India is about 2.4 kg, which is lower than the global average of 7.3 kg but increasing rapidly.[7]

II.II STATE AND CITY-WISE E-WASTE STATISTICS:

- **Maharashtra:** It is the largest contributor to e-waste, accounting for nearly 19.8% of the country's total.
- **Tamil Nadu:** This state accounts for 13% of e-waste generation in India.
- **Uttar Pradesh:** In total e-waste generation, it accounts for 10.1%.
- **Delhi:** The national capital is responsible for about 9.5% of India's total e-waste.[8]

The lack of precise data and reporting procedures exacerbates India's e-waste management challenges, decreasing the effectiveness of policy implementation. The government is attempting to address these concerns through a variety of projects and legislation targeted at improving e-waste management and promoting environmentally friendly activities.

[5] Down-to-Earth, https://www.downtoearth.org.in/waste/indias-e-waste-surges-by-73-in-5-years
[6] data.gov.in, https://www.data.gov.in/
[7] Ministry of Environment, Forest and Climate Change, https://pib.gov.in/PressReleasePage.aspx?PRID=1943201
[8] Ministry of Environment, Forest and Climate Change, https://pib.gov.in/PressReleasePage.aspx?PRID=1943201

Law Audience Journal, Volume 5 & Issue 6, 30th Jan 2025, e-ISSN: 2581-6705, Indexed Journal, Impact Factor 5.611, Published at https://www.lawaudience.com/volume-5-issue-6-2/, Pages: 210 to 222,

Title: E-Waste Management, Authored By: Ms. Vaishnavi Deshpande, B.B.A.LL.B. (Hons.), SVKM's NMIMS, Indore (M.P.), Email Id: vaishnavideshpande222@gmail.com.

III. CHALLENGES IN E-WASTE RECYCLING AND POOR INFRASTRUCTURE:

India mainly relies on the informal sector for e-waste recycling, which has posed several challenges:

1. The financial penalties for non-compliance with e-waste management and processing regulations are ineffective.
2. Because informal sector workers are not properly trained, the general public is unaware of market prices and the health and safety risks associated with e-waste recycling.
3. Investment in large-scale recovery and recycling infrastructure is minimal even though the annual generation of e-waste increases.[9]

The formal sector of recycling in India is also due to poor infrastructure. Officially approved recycling plants process only 20% of the e-waste that is generated every year. The government has a co-funded grant program for 25% to 50% of the cost involved in E-waste management programs, but very few have utilized it. Facilities are operating at suboptimal levels owing to disintegrated supply chains and lack of coordination with the informal sector.[10] In India, formal sector recycling is largely restricted to hand sorting and mechanical disassembly, which normally lacks the large industrial scale and controls, critical to recovering precious and base metals from scrap. There are only a small number of young firms that, starting to extract metals from e-waste, because their processing capacity is minimal. The informal sector uses some hazardous, open-air incineration and acid leaching methods in reprocessing, which greatly increases environmental pollution and health risks.[11] In both the formal and informal sectors, e-waste recycling systems prioritise metal recovery while leaving glass, plastics, and ceramics behind. The presence of flame retardants and other persistent organic contaminants makes it more challenging to recycle plastic e-waste.[12]

[9] Ecoverva, https://ecoverva.com/e-waste-recycling-challenges-in-india-strategies-for-sustainable-solutions/
[10] Ministry of Environment, Forest and Climate Change, https://pib.gov.in/PressReleasePage.aspx?PRID=1943201
[11] Hindrise, https://hindrise.org/resources/e-waste-management-in-india/
[12] WHO, https://www.who.int/news-room/fact-sheets/detail/electronic-waste-%28e-waste%29

Law Audience Journal, Volume 5 & Issue 6, 30th Jan 2025, e-ISSN: 2581-6705, Indexed Journal, Impact Factor 5.611, Published at https://www.lawaudience.com/volume-5-issue-6-2/, Pages: 210 to 222,

Title: E-Waste Management, Authored By: Ms. Vaishnavi Deshpande, B.B.A.LL.B. (Hons.), SVKM's NMIMS, Indore (M.P.), Email Id: vaishnavideshpande222@gmail.com.

IV. LEGISLATIVE FRAMEWORK:

The Indian legislative structure for electronic waste management has changed significantly in recent years. At its heart are the E-Waste (Management) Rules, 2016 (now 2022), an improved version of the E-Waste (Management and Handling) Rules, 2011. The 2016 guidelines included the notion of Extended Producer Responsibility (EPR), which requires producers to prepare for the collection and environmentally sound disposal of electronic waste generated by their products.[13]

IV.I KEY FEATURES OF THE E-WASTE (MANAGEMENT) RULES, 2016:

1. Industries are obliged to design and implement collection systems and achieve targeted annual e-waste targets for e-waste contained in electronic devices. This framework assures that the industry stands liable for the entire lifecycle phase, starting from manufacturing up to its final disposal.

2. Implementation of EPR mandates the industry to obtain certification from Central Pollution Control Board (CPCB). This guarantees that the industries adhere to the defined regulation and finish their collection procedures in a yearly time period.[14]

3. Restriction of Hazardous Substances (RoHS): The handling of heavy metals in electronic devices is controlled and there is defined limit to the amount of certain chemicals (such as lead and mercury). This regulation is used to reduce environmental and health hazards of electronic scrap.

4. Collection Targets: These guidelines have set graded collection goals ranging from 30% of e-waste produced in 2016-17 to 70% by 2023. This would allow producers time to adjust the new scheme and also build the collection infrastructure up over time.[15]

IV.II RECENT DEVELOPMENTS:

[13] E-waste management system, https://eprewastecpcb.in/#/
[14] E-waste management system, https://eprewastecpcb.in/#/
[15] WHO, https://www.who.int/news-room/fact-sheets/detail/electronic-waste-%28e-waste%29

The E-Waste (Management) Rules, 2022[16] came into force from April 2023 and supersede the Rules of 2016. With these new regulations it is even more strengthened in terms of the content of the EPR framework and also new tools for e-waste management are introduced. Producers are to be required today to achieve stricter recycling targets, and to be able to document their e-waste collection and recycling activities. The government has adopted several programs to facilitate the adherence to these rules, such as popularization of awareness, transfer of technology and industry stakeholder engagement. It is aimed at achieving efficient and environmentally sustainable e-waste management system in India.

IV.III EXTENDED PRODUCER RESPONSIBILITY (EPR):

EPR has become a popular strategy, globally for controlling e-waste with producers being held responsible for the disposal of end-of-life articles. The Organisation for Economic Cooperation and Development (OECD)[17] lists two main objectives of EPR. To begin with, it transfers the responsibility for waste management from local governments to upstream producers. Second, through internalizing the external cost of disposal, EPR motivates enterprises to think of environmental impact during product development and promotes recyclable or non-harmful materials.[18]

EPR paradigms impose responsibility on manufacturers in the following ways:

1. Economic Responsibility: Producers contribute to covering the costs of e-waste processing, such as recycling safe disposal.

2. Physical Responsibility: Product Take-Back (PTB) regulations demand that participants must extend collection of consumer-use products and meet certain standards for the amount of products that can be collected.

[16] Ministry of Environment, Forest and Climate Change (MoEFCC), Government of India. *E-Waste (Management) Rules, 2022 (as amended).*

[17] Organisation for Economic Co-operation and Development (OECD) Guidelines on EPR

[18] Policy on Waste Management by Ministry of Environment, Forest & Climate Change, chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://mospi.gov.in/sites/default/files/main_menu/Seminar/Policy%20on%20Waste%20Management%20-%20MOEFCC.pdf

Law Audience Journal, Volume 5 & Issue 6, 30th Jan 2025, e-ISSN: 2581-6705, Indexed Journal, Impact Factor 5.611, Published at https://www.lawaudience.com/volume-5-issue-6-2/, Pages: 210 to 222,

Title: E-Waste Management, Authored By: Ms. Vaishnavi Deshpande, B.B.A.LL.B. (Hons.), SVKM's NMIMS, Indore (M.P.), Email Id: vaishnavideshpande222@gmail.com.

3. Informational Responsibility: Producers are obliged to provide information on product toxicity, recyclability and disposal, usually through labelling.

4. Liability: Liability regulations enforce financial responsibility for environmental degradation resulting from improper disposal.[19]

India's E-Waste (management and handling) Rules, 2011, were originally based on EPR and obliged companies to provide facilities for collecting used devices and to educate consumers to send their used devices for a collection. Nonetheless, preliminary reviews indicated little effect because of inadequate implementation and non-adherence. To this end, the government amended the legislation in 2016 and 2018 setting take-back targets for manufacturers. These targets have been increased first by 10% in 2017-2018 and then by 70% in 2023.[20]

V. CASE LAW AND JUDICIAL INFLUENCE:

Judicial decisions have played a significant role in shaping India's e-waste management environment. A Supreme Court judgment in *Toxics Link v. Union of India (2005)* marked a turning point that highlighted the urgent and imperative need for the overall e-waste framework, and which subsequently brought about subsequent regulations. In this case, the concept of precautionary and polluter-pays principles became highlighted and played a role in the creation of the EPR framework.

VI. GOVERNMENT INITIATIVES AND RECYCLING PRACTICES:

India has undertaken a number of measures to deal with the e-waste management problem:

1. **E-Waste Awareness Program:** The Ministry of Electronics and Information Technology (MeitY) works with industry partners to raise e-waste awareness and

[19] Aprajita Sharma, *E-waste management in India, Policies and Best Practices, chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.itu.int/dms_pub/itu-d/oth/07/15/D07150000060001PDFE.pdf*

[20] Ministry of Environment, Forest and Climate Change, https://pib.gov.in/PressReleasePage.aspx?PRID=1943201

implement capacity building activities. This campaign seeks to educate the public and companies on the necessity of safe e-waste disposal and recycling.[21]

2. **E-Waste Recycling Plants:** In 2023, India had a total of about 468 rechargeable e-waste recyclers with a cumulative annual capacity of 1.4 million metric tonnes (MT). Notwithstanding its potential, its use rate remains low because of the presence of an informal sector. The government is trying to establish the sector and to reduce the recycling rates.[22]
3. **National Resource Efficiency Policy (NREP):** The draft National Resource Efficiency Policy (NREP) suggests practices of resource efficiency and circular economy[23] in the e-waste management system. This policy is directed at reducing waste generation, promoting recycling, and promoting sustainable resource use.[24]
4. **E-Waste (Management) Rules, 2022:** These regulations dated, April 1, 2023, aim at simplifying, e-waste collection and recovery by making producers responsible through Extended Producer Responsibility (EPR). Producers will be bound to annual recycling requirements (either as a function of the amount of e-waste produced or of number of product sold).
5. **Technology Transfer and Collaboration:** The Government has facilitated webinars and developed an e-waste catalogue on the I-STEM national website to encourage collaboration between research bodies and industry. This effort promotes the employment of indigenous and ecologically friendly e-waste handling technology.[25]
6. **Public Awareness Campaigns:** Several public awareness campaigns have been implemented to inform the general public about responsible e-waste disposal and its

[21] MeitY, https://www.meity.gov.in/
[22] E-waste in India - statistics & facts, https://www.statista.com/topics/11764/e-waste-in-india/
[23] Indian Cellular and Electronics Association (ICEA), *Pathways to Circular Economy in the Indian Electronics Sector*.OECD
[24] Press Information Bureau by GOI, https://www.pib.gov.in/PressReleseDetailm.aspx?PRID=1583056&reg=3&lang=1
[25] Reference Report for "National Resource Efficiency Policy" for India, TERI (April 2019)

environmental consequences. These projects aim to affect public behaviour and support responsible e-waste management.[26]

7. **Solar garbage Management:** With the rapid growth of solar power in India, the government is also focusing on managing solar waste. The Central Pollution Control Board (CPCB) has laid down guidelines on safe disposal and recycling of solar panels to avoid environmental pollution.[27]

These efforts demonstrate India's commitment to addressing e-waste management issues and promoting environmentally friendly behaviours. However, there is still a long way to go before these policies are fully compliant and implemented effectively.

VII. SUCCESS STORIES:

- Attero Recycling[28], one of the leading e-waste recyclers in India, employs state-of-the-art technology to recover precious metals from e-waste.
- Karo Sambhav[29]: A producer responsibility organization (PRO) has been collaborating with manufacturers and recyclers in the field of safe handling of e-waste.

VII.I INCENTIVIZING FORMAL E-WASTE RECYCLING:

The Indian government has initiated a point-based reward system, called E-Waste Recycling Credits (ERCs), as a stimulus for formal entities to deposit e-waste in government-accredited recycling plants. E-Waste Rules classify e-waste in categories e.g., laptops, PC, mobile phone, and provide corresponding ERC incentive rates. Organisations are entitled to ERCs in the context of composition and amount of e-waste submitted, including potential use for balancing energy bills.[30]

[26] Press Information Bureau by GOI, https://www.pib.gov.in/PressReleseDetailm.aspx?PRID=1583056&reg=3&lang=1
[27] Press Information Bureau by GOI, https://www.pib.gov.in/PressReleseDetailm.aspx?PRID=1583056&reg=3&lang=1
[28] Attero, https://attero.in/
[29] Karo Sambhav, https://www.karosambhav.com/about-us
[30] CPCB, https://cpcb.nic.in/rules-6/

Piloting ERCs in larger cities like Mumbai, Delhi and Bengaluru over the next 3-5 years may be able to result in system improvements. These centres produce over 70% of India's e-waste and thus make ideal testbeds for such exercises. Co-funding infrastructural improvements at recycling facilities and the creation of state-level incentive programs may also promote small-scale informal recyclers to transition into legal operation and adhere to environmental regulations.[31]

In addition, public-private partnerships (PPPs) have the potential to aid India in the expansion of e-waste recycling facilities, by simplifying the setting up of new installations and linking decentralised collection systems with industrial recycling plants.

VII.II GLOBAL E-WASTE SCENARIO AND BEST PRACTICES:

The earth-waste situation is essentially a complicated and rapidly growing problem. In 2022, 62 million metric tons (MT) of e-waste were generated worldwide according to the Global E-waste Monitor 2024. This number is projected to grow to 82 million MT in 2030[32], making the global collaboration and proper management solutions indispensable. Yet only a few percent of this e-waste are properly collected and recycled, and significant amounts end up in landfills or are recycled under dangerous conditions in the informal sector, mainly in low to middle income countries.[33]

VII.III REGIONAL VARIATIONS AND CHALLENGES:

E-waste creation and treatment procedures vary greatly among regions. Developed countries, i.e., North America and Europe, generally have a higher level of legal structures, advanced reprocessing technologies, and higher collection rates. But they generate a huge amount of e-waste worldwide. Conversely, in developing countries, infrastructure and resources to deal with e-waste officially are often not available, leading to a monopoly in the informal sector and

[31] The quint, https://www.thequint.com/tech-and-auto/tech-news/indias-new-e-waste-rules-could-require-80-recycling-by-2025-bring-in-certificate-trading

[32] The quint, https://www.thequint.com/tech-and-auto/tech-news/indias-new-e-waste-rules-could-require-80-recycling-by-2025-bring-in-certificate-trading

[33] Aprajita Sharma, *E-waste management in India, Policies and Best Practices, chrome-extension://efaidnbmnnnibpcajpcglclefindmkaj/https://www.itu.int/dms_pub/itu-d/oth/07/15/D07150000060001PDFE.pdf*

its associated environmental and health consequences. Illegal transboundary export of e-waste from developed to developing countries worsens the situation.

VII.IV KEY INTERNATIONAL FRAMEWORKS AND INITIATIVES:

Basel Convention[34]: It controls the handling and elimination of hazardous waste, such as e-waste. It is intended to minimize the generation of wastes that might contain toxic substances and to safely dispose of the wastes.

These agencies play an important role in gathering and analyzing global e-waste data, a data set that can be critically useful in understanding global patterns of e-waste and in directing policy making. The UNU-led Global E-waste Monitor, in collaboration with the International Telecommunication Union (ITU) and the International Solid Waste Association (ISWA), is a source of e-waste statistics on a global scale.[35]

VII.V BEST PRACTICES AND EXAMPLES FROM DEVELOPED NATIONS:

Many industrialized countries have developed effective e-waste management systems, providing a wealth of lessons for other countries, including India:

- **European Union (EU):** The EU's Waste Electrical and Electronic Equipment (WEEE) Directive imposes stringent collection and recycling requirements on member states. It emphasises Extended Producer Responsibility (EPR), which requires producers to finance the collection, treatment, and recycling of their own products.

The WEEE Directive also promotes eco-design limits on the application of hazardous substances in electronic items and encourages easier recycling. The EU has also taken a leading

[34] Basel Convention, https://www.basel.int/

[35] Forti, V., Baldé, C. P., Kuehr, R., & Bel, G. (2024). *Global E-waste Monitor 2024*. United Nations University (UNU)/United Nations Institute for Training and Research (UNITAR).

position in addressing the challenges of online marketplaces and their ability to market devices.[36]

- **Japan:** Japan Home Appliance Recycling Law mandates the collection recycling of certain household consumer products, for example, televisions, refrigerators, washing machines, and air conditioners for merchants and manufacturers. Japan has made significant investments in advanced recycling systems, resulting in efficient resource recovery from discarded electronics.

- **United States of America (USA):** The collection of e-waste in the United States is decentralized and governed by state legislation. But a number of states have also set up take-back programs and the like to promote responsible e-waste recycling. The United States is also actively involved in international initiatives to try and stem the illegal e-waste trade.

- **Sweden:** It is e-waste management front runner, possesses a well-developed collection and recycling network along with a high level of public understanding. The government instituted strict regulations and actively promotes the employment of advanced e-waste treatment technologies.[37]

VIII. CONCLUSION:

E-waste management in India requires a complex and unified strategy involving robust policymaking, rigorous enforcement, technological innovations and mass awareness. Although significant outcomes have been achieved in India by enacting the 2016 E-Waste (Management) Rules and several government schemes, several challenges still exist to effectively implement an entirely sustainable framework for e-waste management. These challenges include the informal sector's persistent dominance, deficiencies in technological infrastructure for advanced recycling, inadequate enforcement ability, and low public knowledge of appropriate e-waste disposal methods. Integration of the informal sector into the formal e-waste

[36] Forti, V., Baldé, C. P., Kuehr, R., & Bel, G. (2024). *Global E-waste Monitor 2024*. United Nations University (UNU)/United Nations Institute for Training and Research (UNITAR).
[37] Forti, V., Baldé, C. P., Kuehr, R., & Bel, G. (2024). *Global E-waste Monitor 2024*. United Nations University (UNU)/United Nations Institute for Training and Research (UNITAR).

management chain is a primary objective. All this requires the development of regulations that enable informal waste pickers and recyclers the opportunity for training, safe handling tools and formal employment opportunities in licensed waste recycling facilities. Not only does this formalization lead to environmental and health benefits but it also helps an impoverished social stratum of citizens. Bridging technical gaps is also necessary. Achieving maximum recovery of resources, minimal pollution to the environment, and safe use of hazardous materials can all be enabled by investments in R&D and adoption of emerging recycling technology. This is about promoting technologies for the recovery of high purity metals and rare earth metals from e-waste and developing environmentally benign disposal methods for hazardous materials. As shown in the Global E-waste Monitor 2024, there is a pressing requirement for action. Global e-waste generation will exceed a staggering 82 million metric tons by 2030, with India remaining a prominent contributory. This estimate highlights the scale of the challenge and the urgency of urgent and collective actions to mitigate the environmental and health consequences of e-waste. To design an ecologically viable e-waste management system in India, coupled with a joint and participatory approach among all stakeholders, is needed. This includes all levels of government (federal, state, and local), private companies (manufacturers, recyclers, and dismantlers), civil society organisations, and individuals. Effective implementation and enforcement of the regulation require enhanced inter-agency coordination, enhanced public-private partnerships, and enhanced public awareness campaigns. India can transition to a circular electronics economy through adoption of global best practices, technical invention and stakeholder involvement, all of which will help reduce environmental damage, protect public health and maximise resource recovery.