E-WASTE MANAGEMENT IN UTTARAKHAND

EIACP NEWSLETTER 2023-24

UTTARAKHAND POLLUTION CONTROL BOARD

UKPCB

INTRODUCTION

Remarkable advances in science, engineering, and technology since the early 20th century have created amazing tools and devices that have revolutionised our world and become arguably indispensable in our daily lives. In many developed countries, higher levels of disposable incomes and growing urbanisation have driven a fervent pace of technological change and the adoption of electrical and electronic gadgets. While modern technology has undeniably elevated living standards and ushered in lifestyle conveniences, it has, at the same time, left in its wake two distressing impacts on the environment–pollution and depletion of natural resources. One Such emerging issue is E-Waste. In the present era of Information Technology and boom in Electrical and electronics Industry, there is an emerging issue to handle the waste generated out of discarded electrical and electronic components which is referred as E-Waste (*Mmereki, D., Li, B., Baldwin, A., Hong, L., 2016. The generation, composition, collection, treatment and disposal system, and impact of e-waste. E-Waste Transit. Pollut. Resour. 65–66*). The generation of e-waste has increased significantly in the recent decades. E-waste presents one of the fastest growing waste streams, with an estimated growth rate of 3%–5% annually. [*Cucchiella, F., et al. 2015. Recycling of WEEEs: an economic assessment of present and future e-waste streams. Renew. Sustain. Energy Rev. 51, 263–272; Kaza, S., et al. 2018. What a waste 2.0: a global snapshot of solid waste management to 2050. World Bank Publications*]. As per the report of The Energy and Research Institute (TERI), 2019 estimated generation of E-waste in the country is nearly 20 Lakh Tons of per year excluding import of E-waste.

In 2019, the Global E-waste Monitor 2020 reported a record 53.6 million metric tons of electrical and electronic waste (e-waste) generated, with small electronic devices representing the largest proportion of e-waste, followed by large equipment and consumer appliances.

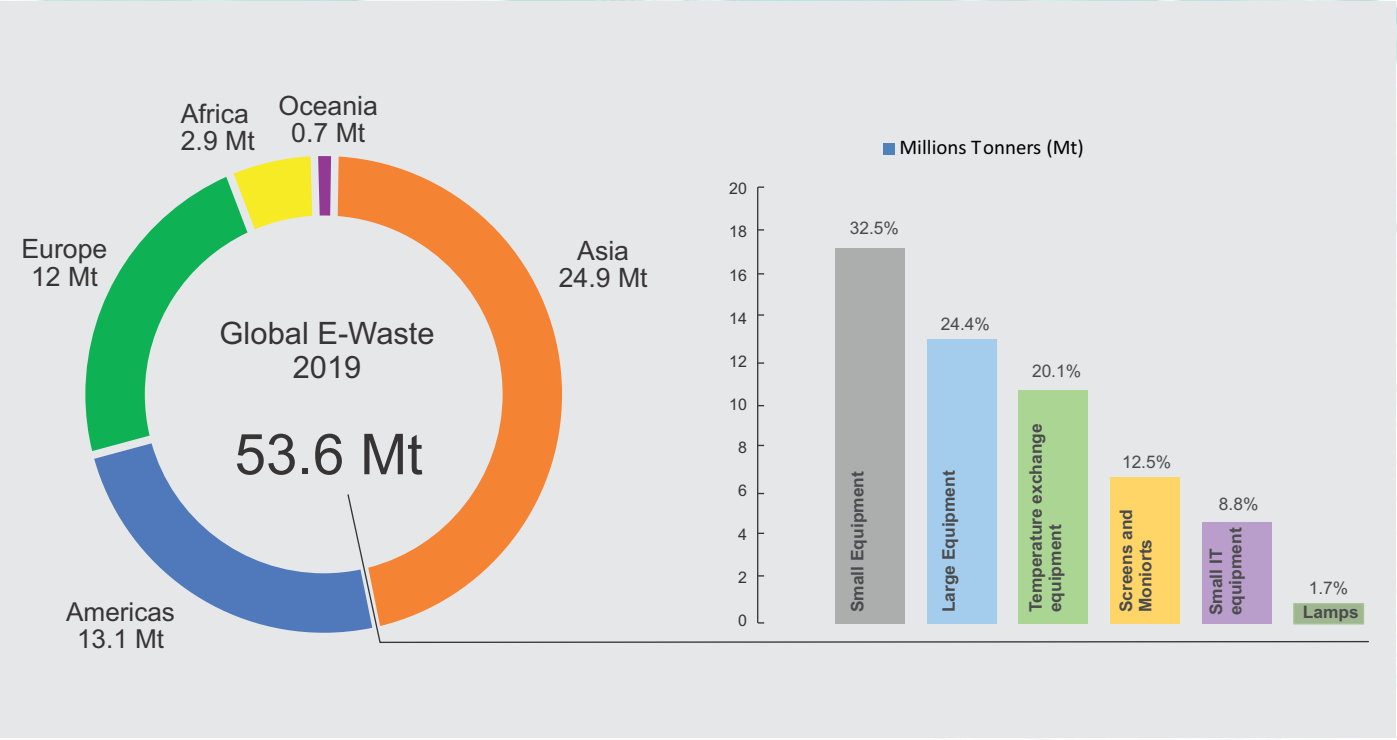


Fig: Global e-waste generated in 2019. Regionally, Asia generated the largest volume of e-waste and Oceania, the least.

It is predicted that by 2030, that global e-waste will increase up to 74 million tonnes, impelled by a burgeoning penetration of electric and electronic equipment in developing countries, a foreseeable replacement market in developed countries and increasing product obsolescence rates [*Forti, V., et al. 2020. The Global E-waste monitor 2020: quantities, flows and the circular economy potential*].

What is E-Waste

E-waste comprises of wastes generated from used electronic devices and house hold appliances which are not fit for their original intended use and are destined for recovery, recycling or disposal. Such wastes encompasses wide range of electrical and electronic devices such as computers, hand held cellular phones, personal stereos, including large household appliances such as refrigerators, air conditioners etc. E -wastes contain over 1000 different substances many of which are toxic and potentially hazardous to environment and human health, if these are not handled in an environmentally sound manner.

According to E-Waste (Management) Rule 2022, 'E-waste' means electrical and electronic equipment, including solar photovoltaic modules or panels or cells, whole or in part discarded as waste, as well as rejects from manufacturing, refurbishment and repair processes.

Why E-waste should be managed

Composed of diverse metals and non-metals, the constituents of e-waste differ across product lines and categories and can contain, in addition to prevailing base metals and varying quantities of plastics and ceramics, both precious metals and rare Earth elements [*Kaya, M. 2016. Recovery of metals and non-metals from electronic waste by physical and chemical recycling processes. Waste Manag. 57, 64–90*]. Waste electrical and electronic equipment (WEEE), however, also often contain hazardous materials including heavy metals such as lead, nickel, chromium, and Mercury, and persistent organic pollutants (POPs) such as polychlorinated biphenyls (PCBs) and brominated flame retardants (BFRs). [*Tsydenova, O., Bengtsson, M. 2011. Chemical hazards associated with treatment of waste electrical and electronic equipment. Waste Manag. 31(1), 45–58; Singh, N., Duan, H., Tang, Y. 2020. Toxicity evaluation of E-waste plastics and potential repercussions for human health. Environ. Int. 137, 105559*].When improperly disposed of, these substances can either be directly released or act as a precursor for the generation of toxic byproducts, resulting in environmental pollution and severe health risks. [*Cesaro, A., et al. 2019. A relative risk assessment of the open burning of WEEE. Environ. Sci. Pollut. Control Ser. 26(11), 11042–11052; Rautela, R., et al. 2021. E-waste management and its effects on the environment and human health. Sci. Total Environ. 773, 145623*].

Global concern of E-Waste is also addressed at International level and at the 16th Conference of the Parties (COP) held in May 2023, Parties to the Basel Convention adopted technical guidelines on the environmentally sound management of e-waste.

A significant amount of e-wastes is generated by consumption of small and large electrical and electronic equipment (EEE). Various sources of e-waste generation, composition of different material fractions and metals content of them are shown in Table 1 with their average percentages. Various types of metals that may present in e-waste are as follows: -

Bulk elements: tin (Sn), copper (Cu), silicon (Si), iron (Fe) and aluminum (Al)

Small amounts elements: cadmium (Cd) and mercury (Hg)

Trace elements: germanium (Ge), gallium (Ga), gold (AU), barium (Ba), nickel (Ni), indium (In), vanadium (V), beryllium (Be), gold (Au), europium (Eu), titanium (Ti), ruthenium (Ru), cobalt (Co), palladium (Pd), manganese (Mn), silver (Ag), antimony (Sb), bismuth (Bi), selenium (Se), platinum (Pt), arsenic (As), lithium (Li) and boron (B).

Table 1: E-waste sources, according to EU directives.

Category of E-Waste	Example	Heavy Metal content (%)
Large household appliances	Refrigerators/freezers, washing machines dishwashers.	Al (1.3–2.0); Sn (1.6–2.0), Cu (2.0–4.1), Ag (0.0042–0.045), Pb (0.021–2.5) Cd (0.036–1.9) [Ref-1]
Small household appliances	Vacuum cleaners, kitchen machines.	Cu (18.8), Pb (4.79), Al (0.912) Cr, Cd, Ni (0.0051–0.0179) [Ref-2]
Information technology and telecommunication equipment	Computers, telephone, mobile phones, copying equipment, printers.	Cu (7.0–30) Al (1.41–14.17) Pb (1.20–6.29) Sn (1.0–3.15) Ni (0.85–2.5) [Ref-3,4]
Consumer Equipment Electrical and electronic tools (except large scale stationary industrial tools)	Televisions, stereo equipment, Handheld drills, saws, screwdrivers.	Cu (10), Al (10) Pb (1.0) Ni (0.3) [Ref-5]
Toys, Leisure and sports equipment	Video games, sports computers, car racing, etc.	Pb (31–34), Cd (30–38) Hg (4.0–16) Cu (0.014) Sn (0.0039) [Ref-6,7]

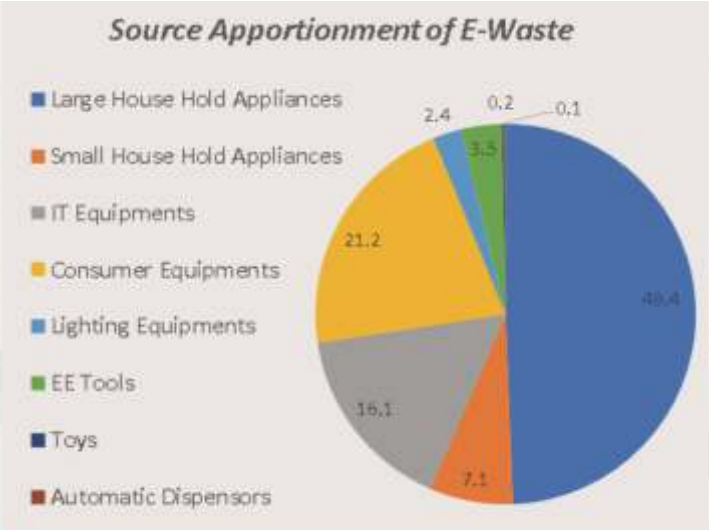
1. *Li, X., Ren, Q., You, X., Yang, Y., Shan, M., Wang, M., 2019. Material flow analysis of discarded refrigerators from households in urban and rural areas of China. Resour. Conserv. Recycl. 149, 577–585.*
2. *Tian, H., He, Y., Liu, T., Yao, Z., 2012. Evaluation on implementation of Chinese 'WEEE catalog policy. Procedia Environ. Sci. 16, 477–484.*
3. *Kantarelis, E., Yang, W., Blasiak, W., Forsgren, C., Zabaniotou, A., 2011. Thermochemical treatment of E-waste from small household appliances using highly pre-heated nitrogen-thermogravimetric investigation and pyrolysis kinetics. Appl. Energ. 88, 922–929.*
4. *Cui, J., Zhang, L., 2008. Metallurgical recovery of metals from electronic waste: A review. J. Hazard. Mater. 158, 228–256.*
5. *Hagelüken C., Art S. Recycling of e-scrap in a global environment–chances and challenges: Umicore Precious Metals Refining. Indo-European Training Workshop. Bangalore & New Dehli. May. 4, 2006.*
6. *Korfali, S.I., Sabra, R., Jurdi, M., Taleb, R.I., 2013. Assessment of toxic metals and phthalates in children's toys and clays. Arch. Environ. Contam. Toxicol. 65, 368–381.*
7. *Miller, G.Z., Harris, Z.E., 2015. Hazardous metals in vintage plastic toys measured by a handheld X-ray fluorescence spectrometer. J. Environ. Health 77, 8–13.*

Table 2: Major constituents of e-waste and their Health effects.

S.No.	E-waste Sources	Constituents	Health effects
1	Solder in printed circuit boards, glass panels, and gaskets in computer monitors	Lead	• Damage to central and peripheral nervous systems, blood systems, and kidney damage. • Adverse effects on brain development of children; causes damage to the circulatory system and kidney.
2	Chip resistors and semi-conductors	Cadmium	• Toxic irreversible effects on human health. • Accumulates in kidney and liver. • Causes neural damage.
3	Relays and switches, and printed circuit boards	Mercury	• Chronic damage to the brain. • Respiratory and skin disorders due to bioaccumulation in fishes.
4	Galvanized steel plates and decorator or hardener for steel housing	Chromium	• Causes bronchitis.
5	Cabling and computer housing	Plastics and PVC	• Burning produces dioxin that causes reproductive and developmental problems.
6	Electronic equipment and circuit boards	Brominated flame-retardants	• Disrupt endocrine system functions.
7	Front panels of CRTs	Barium, phosphorus, and heavy metals	• Cause muscle weakness and damage to heart, liver, and spleen.

S.No.	E-waste Sources	Constituents	Health effects
6	Copper wires, Printed circuit board tracks.	Copper	• Stomach cramps, nausea, liver damage, or Wilson's disease.
9	Nickel–cadmium rechargeable batteries	Nickel	• Allergy of the skin to nickel results in dermatitis while allergy of the lung to nickel results in asthma.
10	Lithium-ion battery	Lithium	• Lithium can pass into breast milk and may harm a nursing baby. • Inhalation of the substance may cause lung edema.
11	Motherboard	Beryllium	• Carcinogenic (lung cancer) • Inhalation of fumes and dust causes chronic beryllium disease or beryllicosis.

Monika & Jugal Kishore (2010) E-Waste Management : As a Challenge to Public Health in India Indian J Community Med. 2010 Jul; 35(3):382-385



1. *Widmer, R., Oswald-Krapf, H., Sinha-Khetriwal, D., Schnellmann, M., Böni, H., 2005. Global perspectives on e-waste. Environ. Impact Assess. Rev. 25, 436–458*
2. *Vats, M., Singh, S., 2015. Assessment of gold and silver in assorted mobile phone printed circuit boards (PCBs). Waste Manag. 45, 280–288.*
3. *Kaya, M., 2016. Recovery of metals from electronic waste by physical and chemical recycling processes. Int. J. Chem. Mol. Nucl. Mater. Metall. Eng. 10, 232–243.*

E-Waste Indian Scenario

- Government of India has notified E-Waste Management Rules in 2016 which were suppressed and new Rules of 2022 has come in to existence which is in force since 01.04.2023. According to the Rules E-Waste is to be managed either by refurbishing or dismantling or recycling
- There is huge gap in E-waste generation and its recycling. Data of E-Waste generation and E-Waste processing since 2017-18 to 2020-21 is presented in the following table:-

E-waste management components	2017–18	2018–19	2019–20	2020–21
E-waste generation in India (MT)	708,445	771,215	1,045,031	1,346,496
E-waste processed in India (MT)	69413.61	164,663	224,041	354540.7
Hazardous waste recycling indicator (%)	9.80	21.35	22.07	26.33

E-waste Generation and Processed data for the years 2017–18 to 2020–21 in India

Source: https://eprewastecpcb.in/dashboard-guest

- A total of 400 E-waste recycling/ dismantling units are operating in the country having potential of recycling is 10.68 Lakh ton. These units are getting only 2.22 Lakh ton of waste so, only 28% of their capacities are being utilized.

Present E-waste Management Practices in India

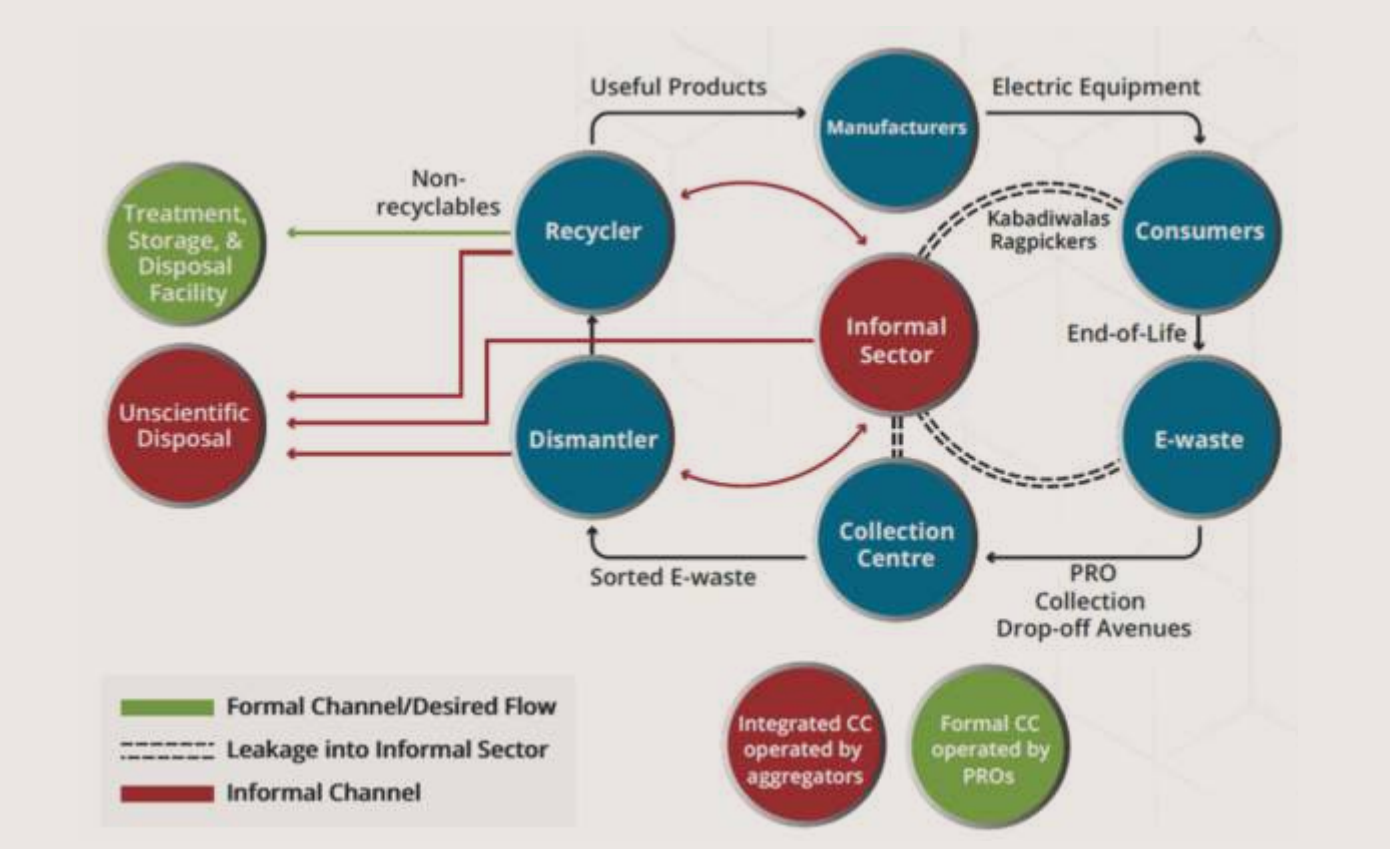


Fig- Showing Typical E-Waste Flow: The value chain of e-waste management is to minimise leakage of e-waste in to informal sector and transformation of informal sector to formal sector and shift from Linear to circular economy.

E-Waste Management is important as it help in compliance of six Sustainable Development Goals (SDGs) which are outlined in the figure

Fig: Showing the Environmental Concern for E-waste Management

Significance of e-waste Management

A National recognition has been given to the importance of e-waste management & e-waste as a valuable resource as a whole. During the 97th episode of Mann ki Baat in the month of January 2023, Hon'ble PM of India, Shri Narendra Modi also highlighted the worth of e-waste management in the country as a step forward towards waste to wealth approach.

Keeping in mind the huge quantity of nearly 50 million/Year generation of e-waste (UN Report), Hon'ble PM brought the Nation's attention towards the necessity of Innovations in this field.

In addition to this, according to the information provided in the Rajya Sabha by CPCB in reply to the unstarred question no. 59 in response to the question of E-Waste Management to be answered by 20.07.2023, Uttarakhand ranks second in the country in terms of recycling of electronic waste.

Need for e-waste rules?

- Electrical and Electronic waste (e-waste) one of the fastest growing waste streams due to high rate of high rate of obsolescence and product replacement.
- E-waste recycling, mostly takes place in the informal sector – not aware of basic environmental norms.
- National Environment Policy has the provision for legal recognition and strengthening of the informal sector for collection and recycling of various materials. In particular enhance their access to institutional finance and relevant technologies.
- E-waste being post-consumer waste requires separate rules to provide effective control on the e-waste channels and its recycling activities.
- 80% of total collection goes to Kabadiwala/unorganised sector

Environmental Legislations of E- waste Management in India

1. E-waste Management & Handling Rules 2011

- It gives voluntarily provision of recycling of E -waste.
- Promoting Collection, Dismantling and Recycling of E- waste.
- Three Level of Recycling has been defined.

2. E-waste Management Rules 2016

- Provision of Producer responsible organization for helping producer in collection of E-waste and Recycling
- Extended Producer responsibility targets were given to producers
- The recycling has been fragmented into three components:
  1. Refurbishing 2. Dismantling 3. Recycling

3. E-Waste Management Rule 2022

- Manufacturer, Producer, Refurbisher and Recycler need to register on EPR Portal of CPCB.
- Producers will be given targets of EPR on the portal.
- Recycler will be given EPR certificate on the portal which can be purchased by producers to fulfil the EPR targets.
- Recyclers are responsible to recover maximum metals from the waste
- Producers will be given composition of metal waste by CPCB for which they have to align with recyclers for metal recovery.
- The EPR certificates once approved by CPCB shall be valid for 2 years.
- Producer can take refurbishing certificate from refurbisher to get extension of EPR targets by 3 years.

Steps For E-Waste management:

Collection

Raising awareness of the importance of E-waste recycling among individuals and businesses, as well as advocating proper disposal practises. Encouraging electronic manufacturers to participate in EPR programmes by accepting their goods at the end of their life cycle.

Transportation

Employing licensed and trained transporters who comply to safety and accountability norms. E-waste should be labeled clearly to prevent spilling or breakage. To maintain openness and accountability, full records of E-waste shipments are maintained. To avoid this, properly packaging of E-waste should be done.

Refurbishing/ Recycling

E-waste dismantling and component categorization for efficient recycling and safe disposal of hazardous items should be practiced. Extraction of precious metals such as gold, silver, and copper for reuse in new electronic products should be ensured. To guarantee privacy and security, sensitive information should be protected during the recycling process, particularly on data-containing devices. However, all possible steps shall be taken to refurbish the waste electrical and electronic component.

Extended Producer Responsibility (EPR) under E-Waste Rules and Targets

Extended Producer Responsibility targets for producers, who have started sales operations recently, i.e. number of years of sales operations is less than average life of their products mentioned in the guidelines issued by the Central Pollution Control Board from time to time

S.No.	Year	E-Waste Recycling Target (by weight)
1.	2023-2024	15% of the sales figure of financial year2021-22
2.	2024-2025	20% of the sales figure of financial year 2022-23
3.	2025-2026 onwards	20% of the sales figure of the financial year two years back

Note: (1) Once the number of years of sales operation equals the average life of their product mentioned in the guidelines issued by Central Pollution Control Board, their extended producer responsibility obligation shall be as per Schedule-III.

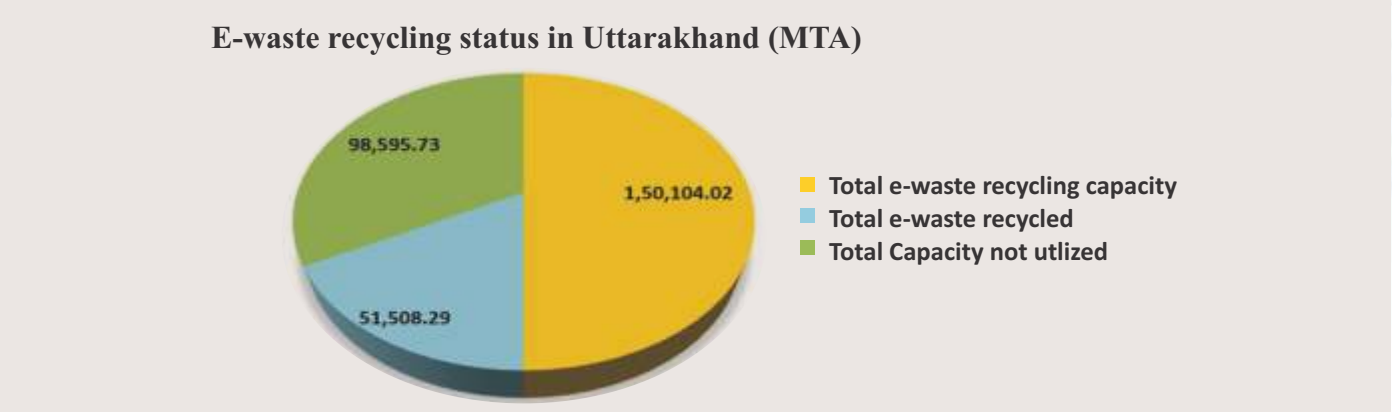
(2) E-Waste recycling targets shall not be applicable for waste generated from solar photo-voltaic modules or panels or cells.

E-Waste Management Scenario in Uttarakhand

In Uttarakhand, 06 E-waste recycling units are established. In the state the e-waste recycling potential is 1.58 lakh tons per year. However, only one third recycling capacity is being utilised. As per annual report of the UKPCB a total of 49297 MT of E-waste generation was reported. Despite of this figure, Uttarakhand ranked second in the Country in terms of e-waste recycling, as per data submitted by CPCB before the Hon'ble parliament.

One of the major units of E-waste recycling namely Attero E-waste Recycling Pvt ltd, Roorkee is having 90% of total E-waste recycling installed capacity of the state. This unit is engaged in extracting of glass, plastic, metals and other valuable and precious components like Gold, Silver etc from the E-Waste. Government of Uttarakhand is also framing E-Waste Policy for the State wherein provision of registration of collection centres is also being made for more effective collection of e-waste and channelization to Recycling centres.

Gap analysis in e-waste recycling capacity of state viz-a-viz actual recycling in Uttarakhand



Main gaps in the E-waste management

- Lack of awareness, least capacity building,
- lack of inventory and mechanism to ascertain quantum of E-waste in the market,
- lack of robust collection model, integration of collection centres with the recycling facilities,
- E-waste collection, transportation and recycling are dominated by informal
- sector such as repair shops, used product dealers, e-commerce portal vendors
- etc, which is well networked and well unregulated, no system of adding value to end-of-life e-component,

Problems being faced in E-waste management

Mismanagement in Market for the End-of-life Products	The inability to reliably source e-waste quantities create economies of scale restricts the entry of private players to set up e-waste management systems in a formal sector.
Inadequate Regulatory Design and Enforcement	The mandatory take-back system for producers, without accompanying collection targets as no incentives to take responsibility and therefore induced little improvements in e-waste management practices.
Inadequate Regulatory Design and Enforcement	Most consumers do not know or have less knowledge about the hazardous nature of e-waste components or the penalties for improper disposal.
Environmentally Unsustainable Informal Sector Practices	Most of these formal facilities are operating below the approved capacities because of inability to source enough waste
Less Information on E-waste Generation Rates	Lack of e-waste inventories due to the unorganized sectors in India.

Solution for E-waste Management

- There is strong need to inventory of E-waste generation, that may be based on the GST data of Electric and electronic goods
- Also, linkage of informal sector into transparent formal sector of recycling will help in channelizing E-waste to authorised recycling units.
- Policy interventions are also required. Besides capital subsidy, Excise exemptions, tax benefits, it will be beneficial to make policy incorporating subsidy on collection targets. For recyclers, targets may be given for recycling of E-waste generating in the country.
- Digital platform is also suggested for registration of each of the producer, manufacturer, bulk consumer and recyclers. All the sale and transaction of E-waste should be made through this platform only. Need to develop system and process at Urban Local Bodies to aid integration with Extended Producer Responsibility (EPR) system.
- Public Awareness is most important for enforcement of any rules. Increasing information campaign, capacity building and awareness is critical to promote environment friendly E-waste management.
- System for value addition for End-of-life E-goods is required to be established to attract end users for channelization of E-waste towards authorised collection centres.

LiFE
Lifestyle for Environment

E-WASTE

UTTARAKHAND

पर्यावरण और स्वास्थ्य के लिए खतरा

ई–कचरा जागरूकता अभियान

“ जागरूक बनें एवं जागरूक करें ”

"कोई भी टूटा हुआ या अनुपयोगी इलेक्ट्रॉनिक्स/इलेक्ट्रिकल गैजेट इलेक्ट्रॉनिक अपशिष्ट या ई–कचरा"

ई–कचरे को जिम्मेदारी से संभाला जाता है तो यह संचालकों के लिए जहरीला और पर्यावरण के लिए खतरनाक नही होगा।

2019 में,
भारत में उत्पन्न हुआ
3.2 लाख
टन ई–कचरा
जिसमें से केवल 10% ई–कचरे को औपचारिक रूप से एकत्र और पुनर्चक्रित किया गया था।

हर उपभोक्ता की जिम्मेदारियां

मरम्मत/नवीनीकरण

नए उत्पाद को त्यागने या खरीदने से पहले इलेक्ट्रॉनिक उपकरणों की मरम्मत/नवीनीकरण पर विचार करें

दान करें

अपना अवांछित दान करें किसी अधिकृत को इलेक्ट्रॉनिक्स ई–कचरा संग्रहण केंद्र

पुनरावृत्ति करना

निर्माता टेक–बैक प्रोग्राम में पूछताछ करें और नामांकन करें या अधिकृत/प्रोफेशन/रीसाइक्लिंग में भागीदार बने।

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