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Formalising The Informal Sector And Creating Opportunity For Employment Generation In E Waste Management

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Abstract : The formalization of the informal sector in e-waste management is imperative for addressing the growing challenges of electronic waste accumulation while simultaneously creating opportunities for employment generation. Integrating informal recyclers into regulated systems involves providing training, resources, and support for safe handling, recycling, and disposal of electronic waste. By legitimizing the activities of informal workers, this approach not only enhances the efficiency and effectiveness of e-waste management but also fosters job creation within a structured framework. Formalization ensures occupational safety, environmental sustainability, and adherence to regulations, thus improving the livelihoods and socio-economic conditions of informal workers. Collaboration between government agencies, private sector stakeholders, and non-governmental organizations is essential for implementing policies and initiatives that support the formalization process. Overall, the formalization of the informal sector in e-waste management represents a holistic approach that addresses both the environmental challenges posed by electronic waste and the socio-economic needs of informal workers, ultimately contributing to a more sustainable and equitable future.

I. INTRODUCTION

E Waste

E-waste, or electronic waste, is any discarded electrical or electronic equipment. E-waste is also known as waste electrical and electronic equipment (WEEE). E-waste pollution is the harmful environmental impact caused by the improper disposal, recycling, and management of electronic waste. Toxic chemicals such as lead, mercury, and cadmium are released into the environment when electronic devices or waste is not properly disposed of, reused, or recycled.

Global Scenarios

The quantity of EEE that citizens use and discard in a given year determines how much e-waste is generated. The patterns, quantity, and rate of generation of consumption vary with the social strata. adjustments as well. enumerates the amount of e-waste produced worldwide by person and overall for the main countries.

Table 1 Country wise rank in waste generation

Rank	Country and rank in e-waste generation	E-waste generation (kg/capita)	E-waste collection rate
1.	China	7.2	16%
2.	USA	21	15%
3.	India	2.4	1%
4.	Japan	20.4	22%
5.	Germany	19.4	52%

E waste scenario: India

India produced 16.01 lakh tones of e-waste in 2021–2022.But just 33%(5.28 Lakh) of the entire amount of e-waste produced was gathered and handled. E-waste can originate from a variety of sources, such as homes, businesses and government buildings, large consumers, manufacturers, and retailers. E-waste can then be recycled. Most of the nation's urban slums handle and process more than 90% of the nation's e-waste.

State Wise Waste Generation

Nonetheless, the top states in India for e-waste generation have been listed by ASSOCHAM and NEC Technologies India Pvt Ltd in their study Electrical and Electronics Manufacturing in India, 2018. These states were also identified as the leading producers

of electronic waste in a 2007 research conducted by MietY, the Manufacturers' Association of Information Technology, and the Gesellschaftfür Internationale Zusammenarbeit (GIZ). The fact that these states all have numerous tier 1 and tier 2 cities in addition to at least one metropolis suggests that EEE penetration is strongest in urban and peri-urban areas. The fact that electronics are only now starting to permeate semi-rural and rural areas implies that the electronic sector still has a lot of locations and markets to discover and capitalize on.

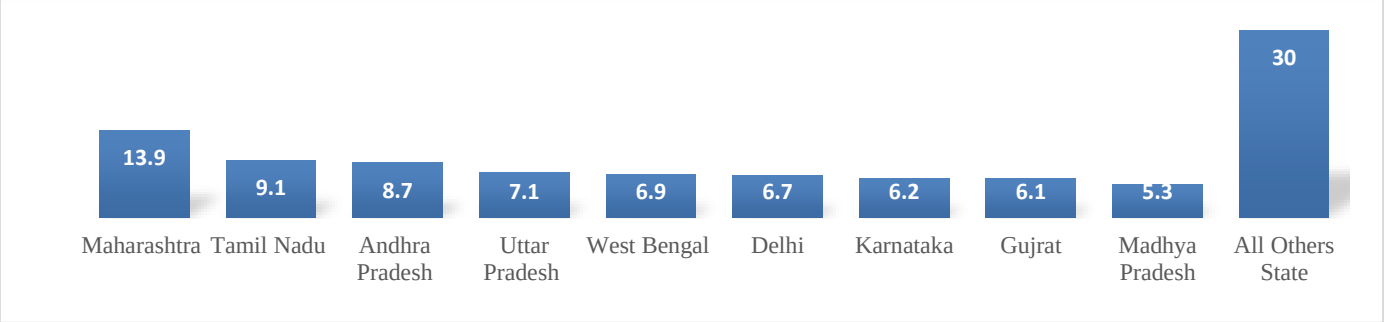


Figure 1.1 State wise waste generation graph

Components of E waste

There are a total of 21 subcategories based on the codes issued to different types of equipment. Electrical and electronic equipment (EEE) is classified into two categories: the ITEW, which includes sixteen types, and the CEEW, which includes five types.

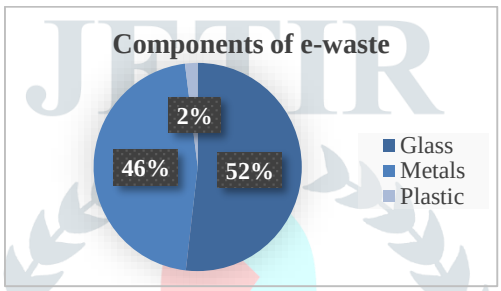


Figure 1.2 Component of e waste

Recyclers Units In India

- Only 18 states in the country have at least one recycling or dismantling facility, with close to half of the recycling facilities clustered in the western and southwestern part of the country.
- 312 Number of Registered e-waste recyclers and dismantlers in India and 7,82,080 mt Total recycling capacity of these units.

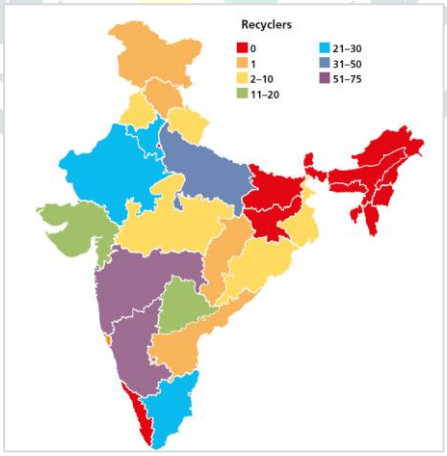


Figure 1.3 Recyclers units on map

II. FORMAL AND INFORMAL SECTORS

Informal sector

In India, the recycling of e-waste has been mostly dependent on the informal sector; different sources indicate that this sector handles about 90% of the nation's e-waste. While this industry has supported millions of people's lives and prevented large amounts of e-waste from ending up in landfills, there are risks to the environment and society that come with managing e-waste in an unscientific manner.

Formal Sector

Different e-waste fractions can be sourced through established supply channels by formal recyclers. Greater amounts are typically acquired through business-to-business (B2B) channels, such as governmental institutions or corporate bulk disposers, who are

obligated by law to work exclusively with approved recyclers. In contrast to the volumes available through business-to consumer (B2C) channels, e-waste from these sources is a small portion of the materials available on the market and continues to be a niche sector.

Table 2 Formal and informal sectors

Parameter	Informal sector	Formal sector
Percentage of e-waste Processed & functions	90 %	10 %
General practices of e-waste processing	Illegal methods: Incineration, breaking, dismantling, dumping, etc.	Industrial recycling and dismantling using technically advanced methods
Binding laws	Not bound by any laws or regulations	Environmental laws, E-waste (Management) Rules, labour laws etc.
Major functions	Collection, disassembly, extraction and dumping	Disassembly, extraction, recycling, treatment and segregation.

The optimal flow for collecting and mitigating leaks in the handling of electronic waste in India

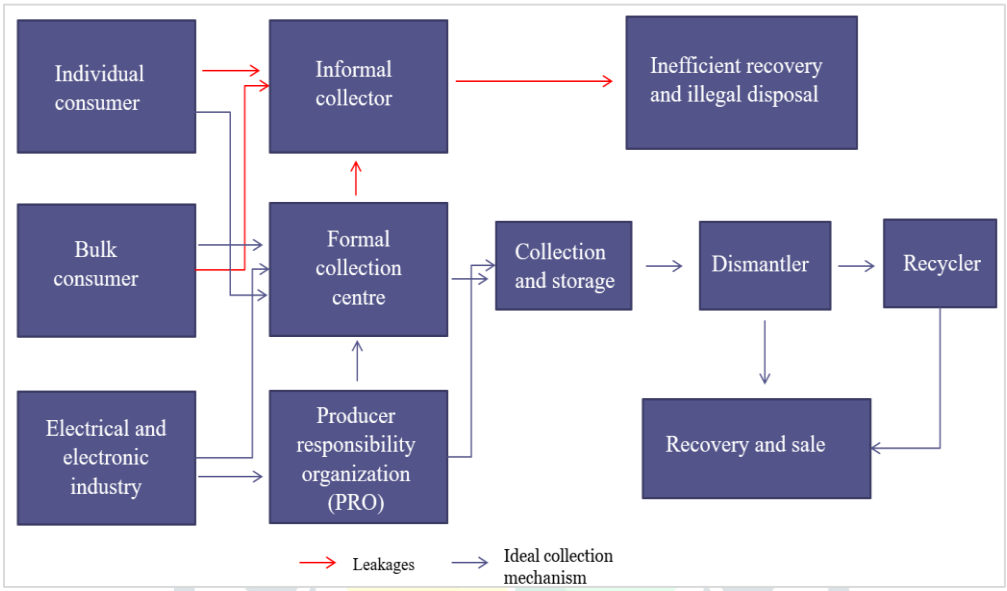
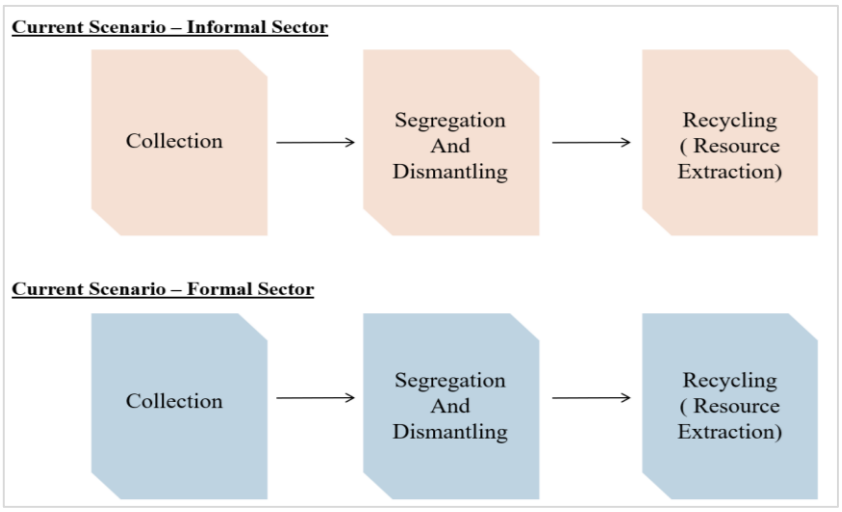


Figure 1 The optimal flow for collecting and mitigating leaks in the handling of electronic waste in India

III. My Concept



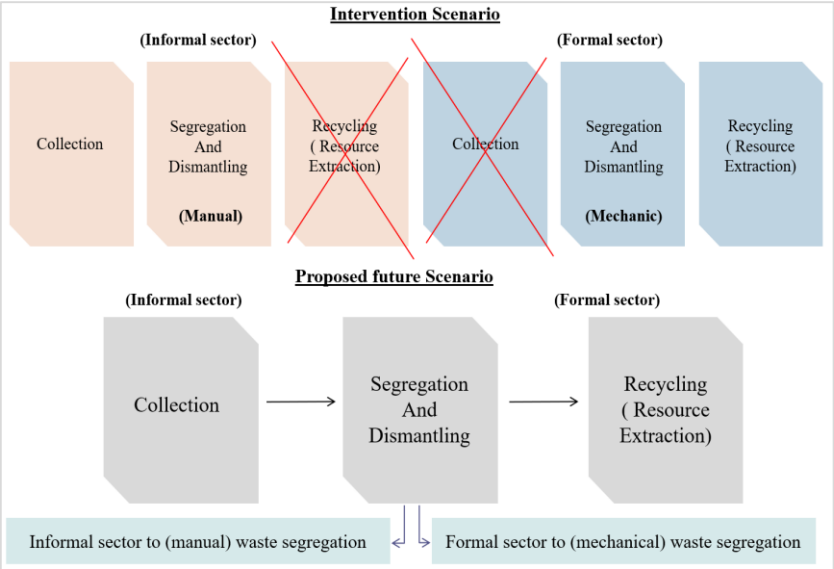


Figure 2 Concept proposed future scenario

IV. ADVANCEMENTS IN E-WASTE MANAGEMENT LEGISLATION

Table 3 E-waste management legislation

Pre -1989	• No rule, legislation, policy or regulation to address e-waste management
1989–2003	• E-waste was bought under the ambit of Hazardous Wastes (Management and Handling) (HWM) Rules (1989, 2000 and 2003) indirectly • Schedule 1 of the HWM Rules covered hazardous material in e-waste composition
2008	• E-waste addressed as a separate challenge • CPCB issued guidelines to all SPCBs in April 2008 to manage e-waste in an environmentally sound manner • Applicable to all stakeholders, viz., generators, collectors, transporters, dismantlers, recyclers, etc.
2011	• E-waste (Management and Handling) Rules were introduced • Enforced from 1 May 2012 • Confirms environmentally friendly handling, transportation, storing and recycling of e-waste • Concept of extended producer responsibility (EPR) introduced
2016	• E-waste (Management) Rules were introduced in 2016 • Enforced from 1 October 2016 • **Concept of Producer Responsibility Organization (PRO) introduced** • Buy-back, deposit refund and exchange schemes introduced under **Extended Producer Responsibility (EPR)**
2018	• E-waste (Management) Rules 2016 amended in March 2018 • Enforced from 22 March 2018 • Target revisions done for new players in the market

V. HEALTH HAZARDS OF METALS IN E-WASTE

Table 4 Health hazards of metals in e waste

Metals	Impact on health	sources
Lead	• Cause to damage the central and peripheral neural system, blood systems and kidney • It effects badly on child brain development, damage to the circulatory system and kidney.	Available in solder in printed circuit boards, glass panels, and gaskets in computer monitors.
Cadmium	It accumulates in kidney and liver.	Available in chip resistors and semiconductors.
Mercury	Cause chronic damage to the brain.	Available in relays and switches, and printed circuit boards.

Chromium	It causes bronchitis.	Available in galvanized steel plates
copper	It causes stomach cramps, nausea, liver damage, or Wilsons disease.	Present in copper wires, printed Circuit board Tracks.
Nickel	Causes allergy to the skin results dermatitis while allergy to the lung results in asthma	Present in nickel-cadmium rechargeable batteries.
Lithium	It can pass into breast milk and may harm a nursing baby.	Present in Lithium-ion battery
Beryllium	It is Carcinogenic (lung cancer).	Present in Motherboards

The recycling process flow for e-waste

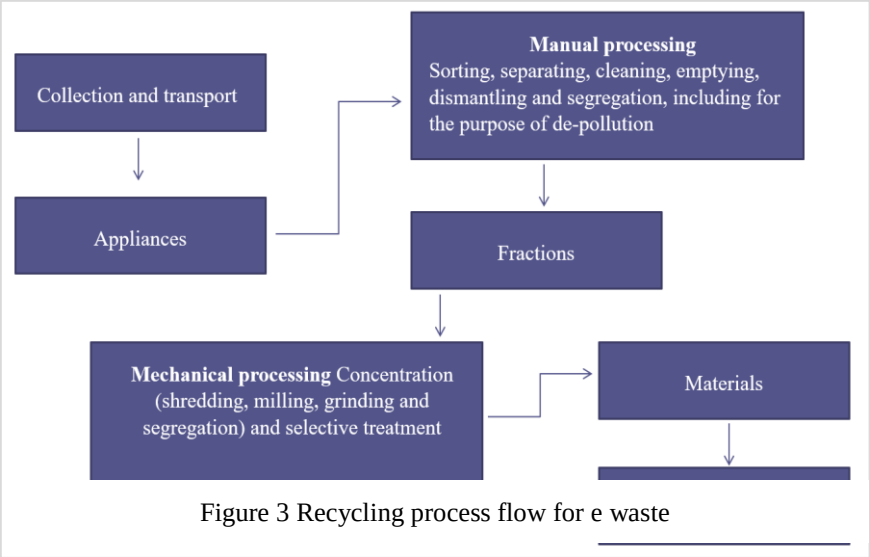


Figure 3 Recycling process flow for e waste

VI. Need of the Study

- According to the CPCB research, e-waste collection and segregation are a major issue in India. The government policy was created in 2016 and put into effect in 2018, however according to the CPCB study, the government has not been able to collect E-waste. By this period, or by 21–22, India was expected to have collected 50% of the waste, but as of right now, just 33% had.
- Electronic product trash disposal is a serious issue that negatively impacts the environment. In addition to causing the release of hazardous materials like mercury, lead, and cadmium during the incineration of the garbage, it also degrades the land because of the liquid that is produced when these materials burn. They thereby have a negative impact on both the environment and human health.
- Only 10% of garbage is collected and managed by formal sectors, with the remaining 90% being handled by informal sectors.

Table 5 Financial year and collection target

Financial year	Collection target (e-waste generation)
2017-18	10%
2018-19	20%
2019-20	30%
2020-21	40%
2021-22	50%
2022-23	60%

VII. Aim

Study Challenges and issues faced in the process of the collection and disposal of e waste.

VIII. OBJECTIVES

- Clarify the problems of waste collection.
- If collected, then what are the main issues.
- Identification of challenges and planning issues.

IX. SCOPE

- The metropolitan cities are considered in study.
- To understand the segregation done by Informal sector and the percentage in which the collection is done by them.
- To provide employment in this sector or by formalising the Informal sector.

X. LIMITATION

- The e waste which is already being dumped without segregation into the landfills are not being considered as part of the study.
- The bio medical waste, floral waste and plastic waste not considered.

XI. METHODOLOGY

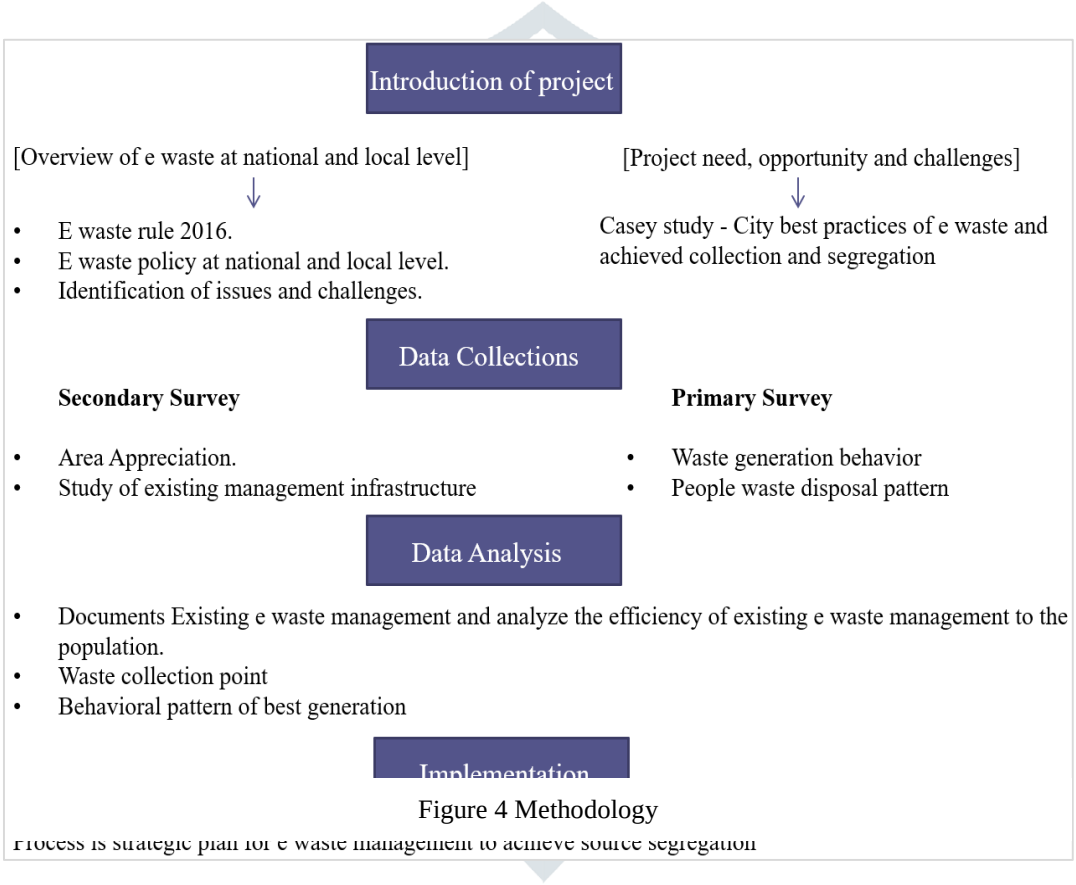


Figure 4 Methodology

Process is strategic plan for e waste management to achieve source segregation

XII. LITERATURE STUDY

Literature 1

Table 6 Literature 1

Paper Name	Publication	Author	Year	Parameter
E-waste issues and challenges in india: a study on management Perceptive	(Researchgate) Mukt Shabd Journal	Dr.V.Ramanujam and Dr. D.Nepoleon	2020	Formalizing the informal sectors

Issues and challenges

- The informal sector is in charge of e-waste collection, transportation, processing, and recycling.
- The industry is unregulated and highly networked. Frequently, not all of the materials and value that may be retrieved end up being recovered.
- Furthermore, there are significant problems with the safety and health of workers as well as the release of chemicals into the environment.

Conclusion

- A suitable framework should be evolving to integrate big organized sector units and small unorganized sector units into a single value chain.
- One strategy would be for unorganized sector organizations to focus on gathering materials, disassembling them, and classifying them, while organized sector organizations could handle metal removal, recycling, and disposal.

Literature 2

Table 7 Literature 2

Paper Name	Publication	Author	Year	Parameter
Electronic waste (E-waste) generation and management scenario of India,	Elsevier	Wasim Ayub Bagwan	2023	Lack of formal sector

XIII. CASE STUDY

Bangalore

Approximately 12,000 tones of e-waste (from computers and accessories) are produced annually in Bangalore. This estimate is based on data obtained from Bangalore recyclers and from the annual 30% of all IT industry equipment becomes obsolete and ends up as electronic waste.

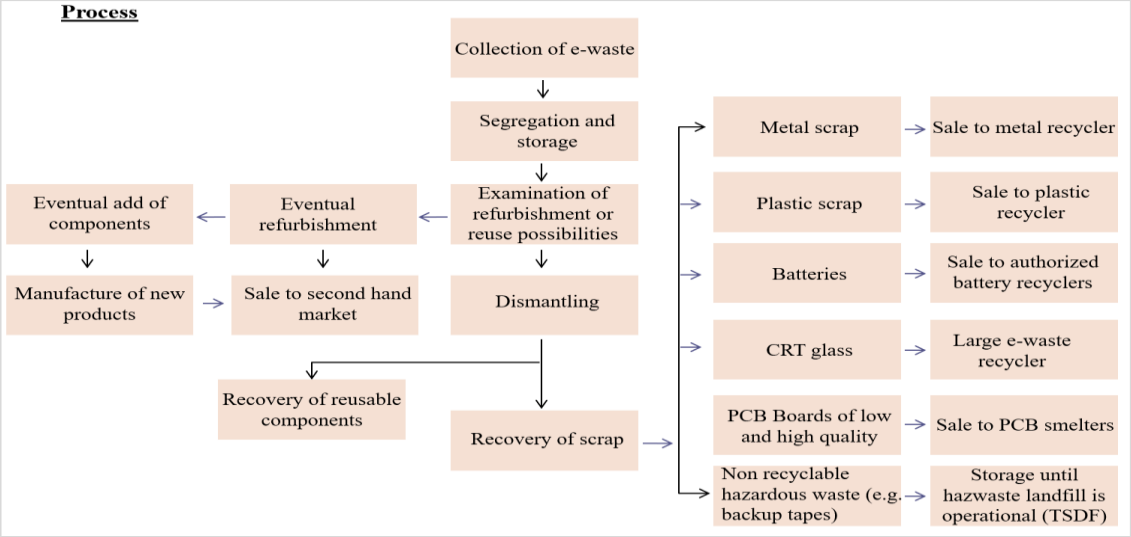
Figure 5 Indian map with Bangalore

The material recovery process at E-Parisaraa, Bangalore, from one tonne of e-waste. the average composition of computer garbage per tonne. Glass makes about 20% of the weight, polymers 23%, and metals 57%. Cables, printed circuit boards, ferrous and non-ferrous metals, and other materials are all sources of recovered metal. One tonne of computer garbage is split into two categories: one for safe land filling and the other for recovering valuable metals. Regarding the recovery of metals by unofficial recyclers, no statistical statistics are available.

E-wardd; (electronic waste recycling dismantling disposal) , bangalore : partnership with formal and informal sector

- Bangalore-based E-WaRDD & Co. is a licenced collecting and recycling business that specialises in electronic and electrical waste recycling, dismantling, and disposal. Mr. Asif Pasha started it in 2009. Before starting E-WaRDD, he worked as an informal recycler in Bangalore's residential complexes, employing about ten people.
- The German Technical Corporation (GIZ) and the Swiss Federal Laboratories for Materials Testing and Research (EMPA) are active partners of E-WaRDD.
- The majority of individuals who maintain rubbish collection in the aforementioned districts are employed in the informal sector. They get damaged products from manufacturers and gather e-waste from homes (door-to-door collection), offices (mostly IT, but occasionally from government departments, academic institutions).
- About twenty persons who were previously employed in the informal sector are employed by E-WaRDD to run the central processing unit and the three collecting centres located in other states. Every employee has access to a steady income, perks from insurance, and the chance to learn new things.

- Meanwhile, 600 tonnes of recycling are done annually by a facility operated by E-WaRDD. The company processes about 200 tonnes of waste a year, but is only able to use one third of this capacity due to restricted waste influx. This is equivalent to almost four million Indian rupees.



Analysis

The goal of the E-WaRDD project is to formally recognise the unorganised industry that manages electronic waste. Under the plan, waste from large customers is directly collected, treated, and then sent to the formal government sector for disposal and demolition.

Figure 2 E WARDD waste collection and treatment process

XIV. STAKEHOLDERS IN E WASTE RECYCLING SYSTEM

Table 8 Stakeholders in e waste Recycling system

Stakeholders		Responsibilities
Management authorities	E-waste recycling Fund Management Center	Operation of the system
	State Council	Release of Regulation
	Authorities from local municipal level, provincial level, and state council level	Planning; Technical policy; Environmental inspection, etc;
Collectors	Retailer	Collection of the e-wastes and submit them to qualified recyclers
	Logistics Providers	
	Repair shops	
Third party Service Provider	Logistics Providers	Transportation
	Quality Inspector	Environmental inspection
	IT service provider	IT service
Producers		Pay the e-waste recycling fee according to market share
Recyclers		Sorting; dismantling; treatment of e-waste
Waste disposers		Landfill or incineration of hazardous material & waste
Consumers		Submit (or sell) the e-waste to the qualified collectors

XV. Potential Of The Study

The amount of electronic devices being wasted globally is increasing, making the study of electronic waste management, or e-waste, imperative. Electronic items that are thrown away, including computers, smartphones, appliances, and other equipment, are referred to as e-waste. Recognising and handling e-waste well possess a number of possible advantages:

Reduction of Environmental Impact

Hazardous elements such as lead, mercury, cadmium, and brominated flame retardants are frequently found in e-waste. Erroneous disposal practices may result in contaminated soil and water, endangering both human health and ecosystems.

Impacts on Health and Society

Research on E-waste management can provide insight into the negative effects that inappropriate recycling and disposal methods have on society and health. Policies and programmes focused at promoting public health and safeguarding the welfare of e-waste-affected communities can benefit from an understanding of these effects.

Employment Creation and Economic possibilities

From collecting and sorting to recycling and refurbishing, the e-waste management sector can generate job possibilities.

Energy conservation

Compared to mining and processing new materials, recycling e-waste uses less energy. Electronic component recycling lowers energy usage, which helps with energy conservation and leaves a smaller carbon imprint.

Consumer Responsibilities and Awareness

Researching e-waste management helps customers become more conscious of how electronics affect the environment.

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