

# A Study on Research-gap in present E-waste Management and an Intuitive App-based Solution

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**Abstract**— Electronic waste (e-waste) refers to the disposal of broken or obsolete e-components. E-wastes may be valuable and recyclable. Most e-wastes requires special handling in their disposal. Due to the rapid advancement of technology, electronic products become trash after a very short span of use. Most electronic devices those are improperly thrown away to a landfill or sold to local rag pickers never get safely disposed of let alone being recycled. These e-wastes contain many harmful materials like lead, copper, zinc, and brass. Due to reprehensible disposal of e-waste, the recycling facility of metals or plastics gets lost and the hazardous element gets leaked in the environment. Hence E-waste is becoming a serious issue as it affects global resource repository, green environment, and sustainability index. This paper paves a path that how does e-waste recycling mechanism can be considered as a service system. The major reason for waste issues, going by our research, comes from the attitude of urban dwellers towards treating their electronic wastes. According to 2016 dictum, the producer has to bear the responsibility of taking back their products. The paper depicts this process starting from a collection of wasted components by recyclers and then recycling it or disposing of it in an eco-friendly manner. Our primary goal is to make this process easier and faster for the end users using an online mobile app. This is an implementation of Extended Producer Responsibility (EPR) where the producer has to be concerned about the product after it gets expired.

**Keywords**— Electronic waste, Harmful, Management Rule, Recycling, EPR, Online App

## I. INTRODUCTION

E-waste includes a very broad spectrum of electronic appliances, products, components, and accessories like computers, mobiles, wearable electronics that - due to malfunction, exhaustion (batteries, light bulbs, and fluorescent tubes), out-datedness, inefficiency or obsolescence have been discarded. This new form of waste is now one of the fastest growing waste streams around the world and needs imperative action today. E-waste is the by-product of the technological revolution. Fast technological trends, low initial costs and even planned obsolescence for profit gain have resulted in a fast-growing e-waste crisis around the globe. When disposed of in a landfill, it becomes a conglomeration of plastic and steel casings, circuit boards, glass tubes, wires, resistors, capacitors, fluorescent tubes, and other assorted parts and materials. It is both valuable as a source of secondary raw material if recycled, and toxic if treated and discarded improperly. We don't understand that in the world of digital technology and electronics, has not only emerged as a boon but also as a bane. It has helped us solve many real-world problems in the most efficient way, nonetheless, it has turned out to be one of the biggest problems when it comes to the disposal

over the years. Whenever we buy a new smartphone, laptop or a camera, we never think about our old devices, what should be the right way to dispose of them without causing harm to the environment, how do we recycle them so that they get a new lease of life and are revolved back again in the economy. Disposing of an old device has a severe impact on the environment as well as on human life, as they contain various semiconductors or elements that are composed of harmful chemicals like lead, cadmium, beryllium or even brominated flame retardants. Up to thirty-eight separate chemical elements are now officially identified as e-waste items and devastatingly toxic. The toxicity is also due to lead, copper, mercury, cadmium, brass, zinc and a number of other substances which constituents most of the electronic equipment. A typical computer monitor may contain more than 6% lead by weight. Hence, before we dispose of our old device, we need to think of the impact it would create and how many lives it will endanger because E-waste is of serious concern due to the toxicity of majority of the substances inside them if it's processed improperly. The unsustainability of discarded electronics and computer technology is another reason for the need to recycle.

As per the 2016 rule of EPR wherein the producer needs to take responsibility for what should happen to their products at the end of their lifetime, either it has to get recycled or disposed of properly. EPR is a policy designed to promote the integration of recycling and properly disposing costs associated with goods throughout their life cycles into the market price of the products. Extended producer responsibility legislation is a driving force behind the adoption of remanufacturing initiatives as it focuses on the end-of-use treatment of consumer products and has the primary aim to increase the amount and degree of product recovery and to minimize the environmental impact of e-waste materials.

## II. LITERATURE SURVEY

While researching about this ever-increasing problem of e-waste, our hearts skipped a beat when we learned that the amount of just the e-waste collected so far is enough to wrap up the earth two times, but the fact that e-waste management still hasn't become an international issue is even more alarming. India itself is the 5th biggest e-waste generator in the world. A recent study by the US has found out that the amount of e-waste produced in India per annum is 3.2 metric tonnes! And by the rate at which it is will reach 20 metric tonnes by 2020! See figure 1.

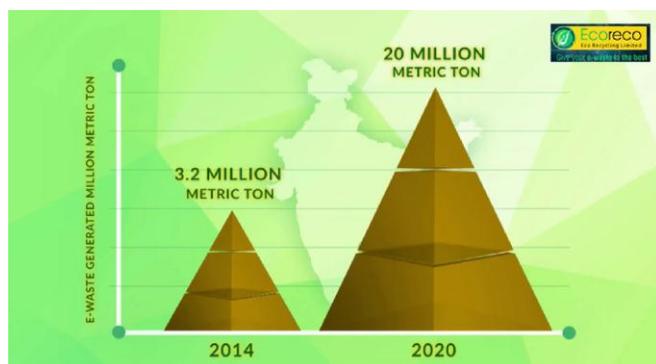


Fig. 1: The US Study of potential e-waste threat as of now and by the year 2020 (Source: EcoReco Company)

And as if that is not enough, another study in 2015 by a group called "Watchdogs" from MIT found out after secretly spying on management processes of the most famous e-waste management companies of developed countries by infusing a tracker into some commodities just to see what actually happens to the e-wastes, found out to their utter surprise that all the e-waste in the name of being "recycled" gets dumped onto developing countries like Africa, China, and India.

It is unfortunate to say that in our own country the conventional processes of managing e-waste are taken care of by unorganized, unskilled, and informal sectors like the

kabbadiwalas. Their methodology not only pollutes the air, water, and soil but also affects the lives of every one of us. They either bury or burn the e-waste in the open or dump it into the waterbodies or landfills. In the bargain, they themselves are the biggest sufferers because such improper treatments of e-wastes not only harm the environment but also badly affect the health of the people doing it. For example, batteries contain lead which is self-sufficient to cause anemia, damage nervous system, kidneys, and gastrointestinal problems or even cause retinal or brain damage. 40% of their income goes into medical expenses and they hardly live beyond the age of 60 years; their children and wives thus get doomed to a life of extreme poverty. E-wastes need to be managed in a safe, specialized and scientific way which is very different from management of other organic/inorganic wastes. Not only individuals but industries also generate oceans of e-waste. Needless to say, these e-wastes are highly toxic and has enough potential to wreak havoc in mankind's ecology and health. It has to be the creator's responsibility to take care of the waste products that the process of creation generates. Hence the need of the hour is to support the organizations that help in recycling the e-waste in an efficient and eco-friendly manner. We are rejoiced and confident that by the successful implementation of e-waste management rules (EPR) declared in 2016 in the country, we will be able to achieve two major objectives: -

- a) The deployment of resources will happen with the implementation of the recycling system in place. And the e-waste rather than going deeper into the landfills, waterbodies, being burned or buried will instead be recycled and thus get reutilized the same industries for the redeployment of commodities.
- b) We will be able to continually provide business and the employment to the unorganized sectors like the kabbadiwalas to continue to feed their families in a very healthy manner after giving them proper skillsets.

The government's primary aim while declaring EPR rules was to at least recycle 1 metric ton of the e-waste out of 3.2 metric tonnes generated every year in our country. And in order to match the aim and reach our objectives we need to put three things in place: -

- 1) **Training** of informal sectors and unskilled like kabbadiwalas so that we can get them integrated into the process of the formal chain of the collection.
- 2) **Transport** - Collection systems and reverse logistics need to be highly efficient in spreading the awareness to the urban dwellers who are now going to the informal unorganized sectors and giving away their e-wastes for being improperly disposed right now to instead come into a formal system of collection.
- 3) **Technologies** - Heavily invest in top-notch technologies to recycle e-waste

For proper waste management of electronics wastes, many companies have set their entire focus and vision into managing e-waste in India like **EcoReco**, **JSPigments**, **Attero**, **E Parisaraa**, **Namo E-Waste Management**, and many more, but we still can't admit that the problem has been really solved. These companies identified that managing e-waste has become one of the primary concerns as the ever-increasing number of devices that human life has to rely on is increasing day by day, making it highly essential to managing e-waste in a sustainable and greener way so as to also not affect the health of the people doing the job. These E-Waste Management companies are pioneers in e-waste management and electronics recycling, with its top of the line services using top-notch machinery and scientific methods to efficiently manage, dispose and recycle discarded electronic items. Our motto includes comprehensive and eco-friendly recycling services as well as end-to-end e-waste recycling and valuable metal extraction and disposing of toxic remnants safely solution. With enough capital, these companies have a state-of-the-art facility for extracting reusable resources from electronic waste under the supervision of its highly skilled staff who pay maximum attention to ensure that all the recycling tasks are carried out in an eco-friendly manner. These companies also get the full support of the National Skill Development Corporations for training the kabbadiwalas and thus uplifting their lives by training them on Safety, Health, Environment, Regulations (SHER) and make them more efficient to manage the collection process.

a) **E-waste Collection:** The process of e-waste management starts with the collection of e-waste from the residence and urban dwellers to various locations. The companies have their own fleet of trucks to do that. Then at the locations, these e-wastes are weighed and segregated and transported to the recycling facilities. Once brought there, the e-wastes are divided into categories of the type of commodities like monitors separately and mobiles separately, and so on. If there is a possibility that the product can be repaired then it is repaired otherwise it is dismantled and the leftover components are passed on to shredding.

b) **Dismantling:** Extraction of precious metals like aluminum, copper, and silver from printed circuit boards using costly extraction units happens and then the e-waste which contains hazards elements that cannot be further recycled or reused goes for scientific and secure landfill at authorized hazardous waste treatment units and disposal facilities for final disposal in its endeavor to not only protect the environment but also the security of data in e-waste like CD-s and HDD's which contain personal data.

c) **Sorted:** The segregated components are sorted and toxic materials are kept separately, the bulk e-waste will be shredded.

d) **Recycling:** The components that can be recycled are sent to recycling firms. Throughout the entire process, different types of hazards are treated differently: -

- **Lead Recycling Process** - After the batteries are collected or plugged-out of commodities, they are broken and separated. Then the paste is desulfurization and melted with reduction operation of paste. Then melting of the grid, refining of crude lead, slag process, gas cleaning system, acid neutralize and effluent treatment.
- **Copper Recycling Process** - Once collected it is processed through a chopping line, which granulates the insulated wire, allowing copper to be liberated from any insulation. The granulated material will cross a screener, then a density separator, capturing recovered copper chops that will later undergo a quality inspection before being transported to a rod mill for usage.
- **Brass Recycling Process** - Once collected, the Brass is segregated into grades and then eventually melted down reformed into billets and ingots for reuse.
- **Zinc Recycling Process** - The process of zinc recovery involves the collection of disposed Zinc where recovery starts with the separation of zinc-containing metals from other materials typically by magnetic, sink-float, or hand sorting followed by pretreatment, melting, and refining.

The recovered materials from all the above processes are then passed on to forward production process for reutilization. The entire system of recycling is based on the principles of clean environment and minimum landfill requirement. The flowchart of the entire process is given in *Figure 2*.

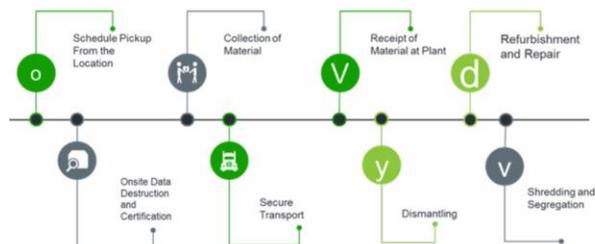


Fig. 2: The Process followed by major Companies.

### III. METHODOLOGY

**reUSE Me! - The E-Waste Management App:** It is an android application to serve our purpose of making the collection of e-waste easier and faster.

- **Flowchart:**

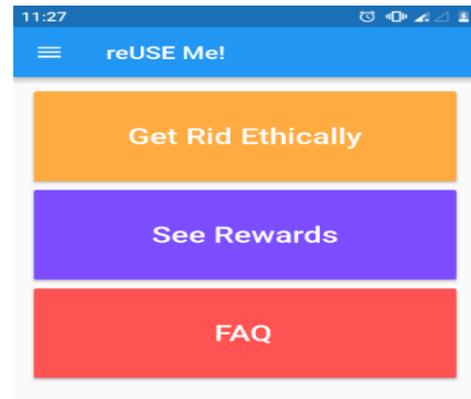
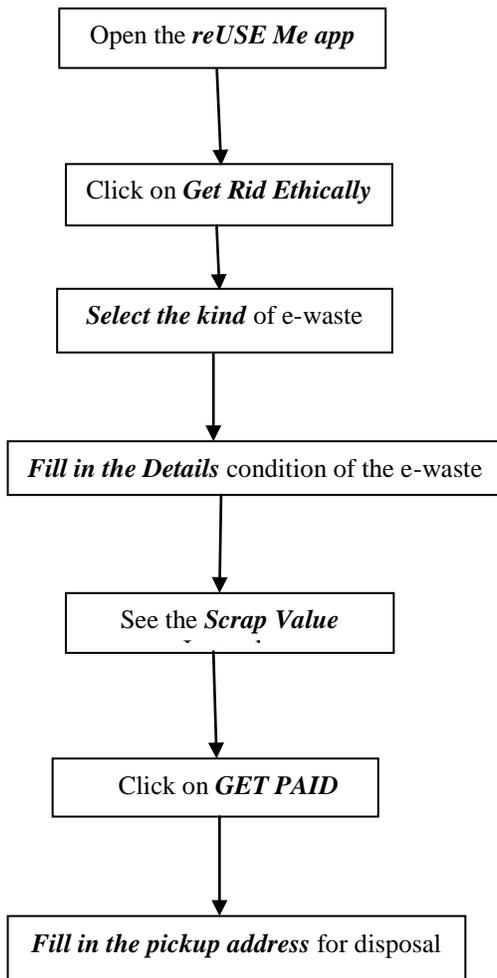


Fig.4: Options in App

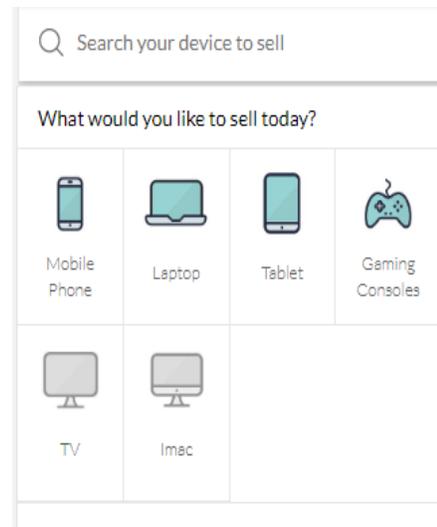


Fig.5: Select the Type of E-waste

• Screenshots of reUSE Me app:



Fig. 3: Open reUSEMe App

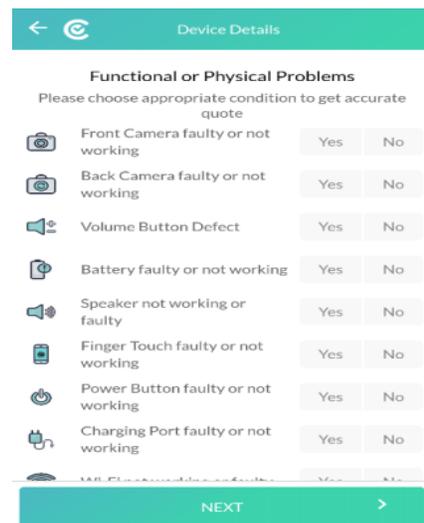


Fig.6: Answer a Questionnaire

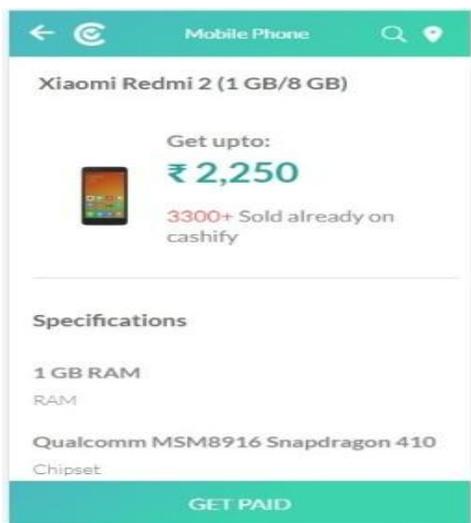


Fig.7: See Scrap Value

#### IV. RESULTS AND DISCUSSION

The major reason for this problem, going by our research, stems from **the attitude of urban dwellers towards disposing of their e-waste**. Not blaming anyone, this unhygienic attitude has solely come due to **lack of awareness about the hazards these e-wastes can cause**. This unawareness has caused people to think only about the gains they could derive by selling their e-waste to local rag-pickers and unorganized, unskilled, and informal sectors like the kabbadiwalas (neither of them has any idea of proper disposal of the e-waste let alone recycling it) at a minor higher price rather than selling it to recyclers at relatively low prices for proper recycling and disposal. Most of the recyclers we visited during our research complained about this unawareness as their major roadblock in why most people don't give their e-waste to them for recycling. The root cause of this unawareness is that people see their e-waste as any other waste which has no purpose or use; they simply fail to recognize these e-wastes as an asset for reutilization. Our primary task is to change this attitude of people by making the process of supplying the e-waste from user to recyclers easier and faster and also increase the awareness about the hazards inside these e-wastes like lead, copper, zinc, brass, and mercury can cause so that people are not left with any excuse to not to give their e-wastes to recyclers instead of giving it away to the local kabbadiwalas. Why would anyone spend their time, energy and travelling fares to carry their e-wastes and themselves just to reach to the recycling centers to give away their e-wastes, anyway? The problem that we are primarily addressing is in the collection phase of the e-waste management system. Although many measures have been taken by these big shot companies for proper collection of e-wastes, still the gap is huge because not many of the unorganized and informal

sectors like kabbadiwalas are recruited, trained or formalized to manage these e-wastes properly. Instead of utilizing these kabbadiwalas as a ground-team asset for proper collection of e-waste (which has been done by the way), it is becoming more like a race against them. And that is where our mobile application comes in which will enable the end users or the urban dwellers to not only get to know the exact scrap value of their e-waste but also Request a Pickup easily and hassle-free and just a few clicks away.

#### V. CONCLUSION AND FUTURE SCOPE

A sustainable and healthy society is only possible when every individual step forth to do their bit and become more and more conscious about the electronics that we are using after their life expires. As one of the major resource regeneration industries, e-waste recycling can help solve the resource shortage and environmental pollution problem, ensuring sustainable development. The unimaginable comforts that technological advancements have gifted us will not take much time before turning into a doom if proper awareness about the e-wastes is not spread among the urban masses. The reUSE Me android application is our step forward in the direction towards a greener and efficient environment.

Furthermore, as a future scope, the system can be enhanced for data mining, to establish a sustainable solution for e-waste handling and features including the same can be propelled as version updates of the application.

#### VI. ACKNOWLEDGMENT

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#### REFERENCES

- [1] No. 551 Order of the State Council of the People's Republic of China, Regulations for the administration of the recovery and disposal of waste electronic and electronic products. 2009. [3.www.chinaenvironmentallaw.com/.../regulations-on-waste-electricand-electronic-products-chn-eng.pdf](http://www.chinaenvironmentallaw.com/.../regulations-on-waste-electricand-electronic-products-chn-eng.pdf)
- [2] Research on Innovative Information-Flow Management of E-Waste Recycling Network Based on Cloud Computing Kejing Zhang<sup>1</sup>, Ping Cang<sup>1</sup>, Jutta Geldermann<sup>2</sup>, Fugen Song<sup>1</sup>
- [3] E-Parisaraa Private Limited - <http://ewasteindia.com>
- [4] Ecoreco - Eco Recycling Limited - <http://ecoreco.com/>
- [5] J S Pigments Private Limited - <http://www.jspigments.com/>
- [6] ATTERO - Electronics Asset Management Company - <http://www.attero.in/>

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