

# Choosing Green Electronics to Overcome e-Waste by Recycling

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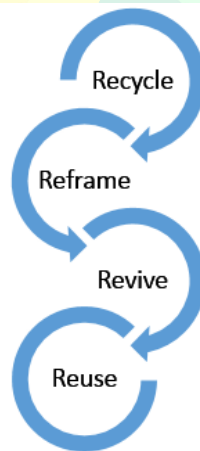
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**ABSTRACT:** *In the modern world today everything is getting smart and automatic with the increased involvement of a no. of electronic gadgets and new emerging devices. At the application level, it looks so innovative and achievement of scientific researches but on the other hand in the production of these smart gadgets, there is a lot of burden of e-waste on our planet. In this paper, some techniques have been discussed about the nature of e-waste and how to control or reduce it to prevent the environment by choosing the concept of green electronics. Various methods can help in the reduction of e-waste and also focus on the extraction of useful things out of waste. From a future perspective, green electronics will be proved as one of the smartest choices by humans to control reuse and recycle e-waste. This paper will help learners and researchers to understand the concept of green electronics practically in daily life.*

**KEYWORDS:** *Environment, e-Waste, Green–electronics, Recycling of e-waste, Bio-degradable, Nature.*

## 1. INTRODUCTION

Green electronics is a concept which is a combination of two words that are green *plus* electronics. In this complete term of green electronics, the ‘green’ refers to use of environment friendly products that do not harm the environment and also gives less residue in terms of e-waste. Electronics refer to the hardware components that are being are not properly disposed off, after their use. The improper disposal of the electronic products may lead to a large burden on planet. It may cause serious health issues to humans in upcoming time. So in present, all should take integrated steps in order to treat the e-waste. There are 3 main steps to treat the e-waste. These steps are inter-related to each other and reduced e-waste is the end product of whole process. In Figure 1. Three main steps are shown on the basis of which, e-waste can be well treated.

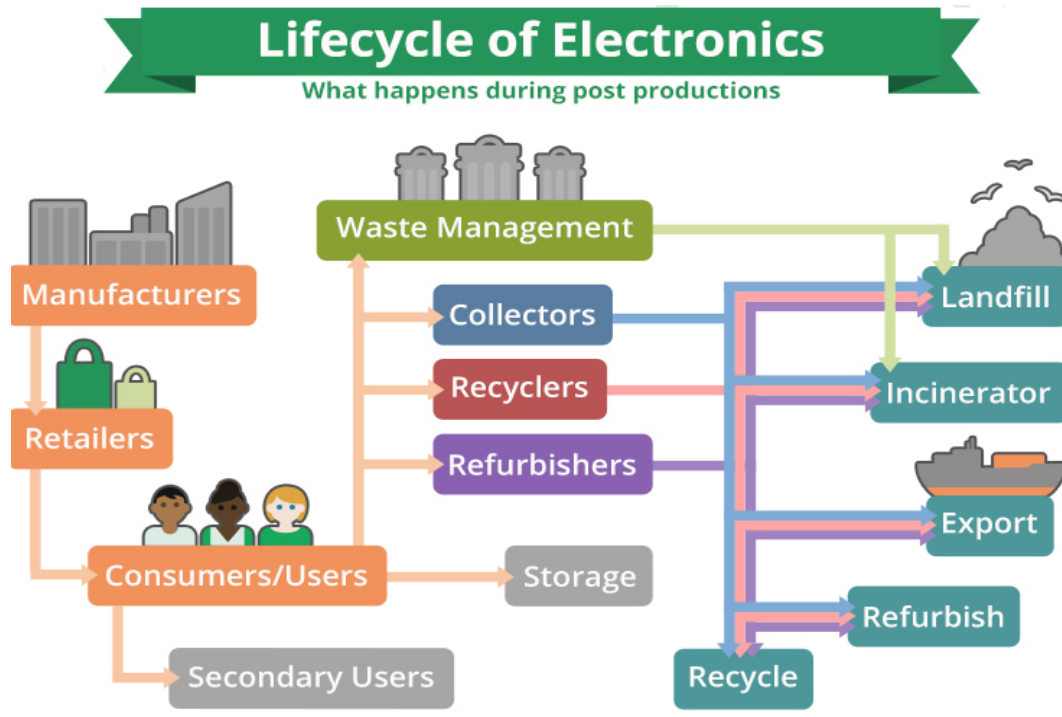


**Figure 1: Steps to Control e-Waste**

By following these steps e-waste can be controlled and reduced up to an extent. Various techniques of recycle are there that extract the good things out of waste and also convert waste in some useful form of matter. Now to reduce e-waste and to recycle e-waste, first it is very important to understand, what actually e-waste is? To recycle the e-waste its characteristics and nature is important to understand. Here is a brief discussion about e-waste. Many of the researchers gave different definitions of e-waste in accordance to their knowledge.

### 1.1 Definition of E-Waste:

E-waste is characterized as the waste material produced by electrical and electronic equipment, as well as all sub-assemblies and consumables that are part of the product at the time of disposal. E-waste is described as any appliance that uses an electric power supply that has reached the end of its useful life, according to the Organization for Economic Cooperation and Development (OECD). Another concept comes from a unified body tasked with resolving E-Waste issues. (STEP) defines e-waste as “the reverse supply chain that gathers goods that a given customer no longer wants and refurbishes for other customers, recycles, or otherwise processes wastes.”[1]. By considering these definitions from different organizations working in this direction, it can be clearly understood that electronic waste talk about the improper disposal of electric components after its use and that improper disposal may lead to, a lot of e-waste generation on earth. Now, after use and production of electronic components what happened next to them can be illustrated in Figure 2.



**Figure 2: Life cycle of electrical and electronic and electrical components**

The waste management bodies collect the waste material recycle the waste components and refurbish it. These are the general steps that are followed by waste management bodies. The strategies adopted further are landfill, incineration, export and recycle.

### 1.2 Bio-Degradable Electronics:

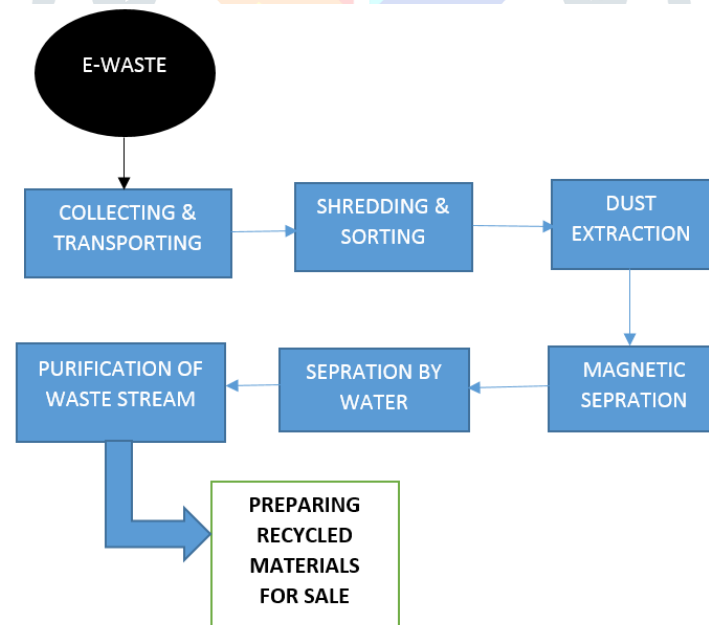
The term green electronics and use of biodegradable electronics are meant to be same. Biodegradable electronics are those products that are electrically active but after being used completely they act as degradable products and decompose in order to not increase e-waste on earth. In production of biodegradable products these days, companies are more focusing on using organic materials such as carbon based (CNT–Carbon Nano Tube), conjugated polymers, nature originated molecules instead of typical products like bulk silicon, metal oxide, alloys of silicon that produce a lot of e-waste. The movement towards biodegradable products is initiated with various changes in production techniques and material used. The processing and final products extraction along with designing is all about the changes. Production companies should adopt new techniques and strategies that may change the whole picture of e-waste, in some years. Not only change

in production process and materials chosen but, new ideas need to be implemented on a large scale to reduce the e-waste.

Some of the changes in processing methods are there such as: instead of using lithography, thermal evaporation, e-beam evaporation, MOCVD, and other chemical vapor deposition, the processes like, spin coating, ink jet printing, screen printing should be used. The products manufactured on the basis of these changes, will be degradable and produce less waste. Their effects will be environment friendly or neutral. At least these bio degradable products will not hamper the environment. Here the question arises that how these bio degradable products are formed? Well there are certain products that play important role in production of bio degradable electronics. These materials are substrate made up of bio degradable polymers. As green electronics awareness is increasing these days, the contribution of polymers is shifting towards synthetic polymers. An active layer in electrical devices is the working thing that runs the device. Inorganic semiconductors are now much replaced by organic material based semiconductor. The materials of electrodes, that is responsible for conductivity in electronics devices is used now a days made up of noble metals due to the reason of their less reactive nature and less corroded. The dielectric layer in devices is very important for the conduction of current in circuit, thus focus should be on the change of material used in dielectric. Because of dielectric polarization, when an electric field is applied to a dielectric, positive charges travel in the direction of the applied field and negative charges move in the opposite direction[2].

### 1.3 Recycling of biodegradable/Green electronics:

Methods of recycling e-waste depends upon the material that can be recycled. Various types of materials are there present in e-waste that can and cannot be recycled. Those materials that can be recycled are plastic, metals, glass and mercury. Some other materials that can be recycled are batteries, toner, ink cartridge, circuit boards and materials that falls in these categories can be recycled. The process of recycling is not as easy it sounds to be. There are various steps involved within process regarding recycling of electronic wastes that are performed one by one. Here in Figure 3, it is shown in a block diagram illustrating how the recycling is done.



**Figure 3: Block Chart of Recycling of electronic wastes.**

The e-waste is first collected and transported to waste management bodies. Then waste is shredded and sorted and extraction of dust is done with the help of water streaming and after magnetic separation, recycled material is out for sale.

#### 1.4 Benefits of Recycling of e-waste:

There are various applications of green electronics or using bio-degradable electronic devices. The most advantageous thing about green electronic is that it is environment friendly and produce less e-waste. Ultimately reduction in e-waste, is the major achievement for nature and humanity. Some of the common benefits of recycling of e-waste are listed as

- With recycling of e-waste, the natural resources as well as minerals can be conserved for upcoming generation.
- Recycling of electronic wastes, reduces amount of electronic wastes on earth then hence, recycling is considered an environment friendly process that prevents the nature.
- Somewhere, recycling of e-waste either directly or indirectly creates jobs and helps to treat unemployment in nation. People will be involved in collecting and sorting process and seminars for awareness as well.
- Recycling of products also prevents extra landfilling and ultimately reduces global warming. Pilling of e-waste on land and incineration has already harmed a lot nature in terms of global warming so, recycling is the ultimately solution [3].

## 2. LITERATURE REVIEW

Daniel Mmerekı et al. presented a research paper discussing about healthcare e-waste organization. According to author, the health care waste material is stored, collected and treated, disposed of in such a way that extraction of something good material can be done and rest is recycled and disposed. Various health care waste management techniques have been mentioned and disposal system is also shared by author. Author classified different types of health care solid wastes such as general solid waste, health care waste that are infectious, waste from pathological department, waste from chemical and pharmaceutical usage and rest are sharps these are composited by syringe, surgical waste, organ fetuses, broken glass, glasses, drugs and scalpels etc. all of these material is too measured like e-waste [4].

Fayz Ali et al. discussed about the conceptual model of green purchasing intention where, green thinking as well as greener inherent incentive with greener unselfishness has been considered as initial elements of model. Various factors have been analyzed by author such as greener thinking's, greener buying incentive, green extrinsic motivation, greener unselfishness, with a no. of variables. These variables are gender, age, education, income etc. as a result, an estimated model has been suggested by author that illustrates different values of variables and their correlation with factors. In short, according to author, companies should adopt such models and methods that are aimed towards green electronic production and consumption.

Daniel Mmerekı et al. presented a research work in which a brief discussion is done about e-waste management is done. Author described about collection of e-waste, disposal of waste material, proper treatment of waste and illegal trading of this material. These are the key features of discussion. Different types of definitions have been provided by author according to EU-WEEE STEP, OECD. The author concentrated on the first major issue, which is e-waste generation, as well as terms like e-waste composition and e-waste disposal volume. The main research concepts are e-waste collection, treatment, and disposal systems[5].

Wang Jin Fen et al. presented a novel method in a research paper about flexible and implantable electronics to record brain activities. A large grid neuro-grid is discussed which is an organic material based mesh electrode array that is fabricated by traditional methods and syringe-injectable mesh electronics and high density neuro-tassel. Ultra-small nonelectric thread and multifunctional electronics are the major terms discussed by authors in this present work. Highly densely packed tiny particles neurons were made using standard fabrication techniques and featured a free-standing section with a plane-mesh-filament structure to increase overall structural integrity.

Mihai Irimia Vladu et al. presented a report about green and biodegradable electronics. A pictorial view of electronic waste has been shared by author in this report. Substrates and insulators are considered as part of electronics waste and found to be bio originated. Explorations regarding bio companionable leading products

have already been considered a vivacious field in this paper. In this research work, bioorganic substrate in addition to plant originated dielectric results in semiconductors and further fabricated chips are the main ground focus in this paper. The use of plants and biodegradable products is the main aura in this paper in context of production of electronic products.

### 3. METHODOLOGY

In the purposed methodology, a survey has been done on 100 people out of which 90% of the randomly selected people responded positively in survey. A questionnaire is prepared in which some questions were asked related to the electronic products. What people carry in their minds while selecting an electronic product for purchase. Different parameters have been taken under consideration and observations has been shared in tabular form in Table1 and 2.

**Table 1: Details of randomly selected samples for survey.**

S. No.	Age group	No of people	Occupation
1	20-25	10	Student
2	26-30	22	Private job
3	31-35	35	Govt. job
4	36-40	13	Teacher
5	41-45	6	business
6	46-50	4	Retired

Most of the people are randomly selected and found to be engaged in some occupation. The age group of 46-50 were found to be less active in survey but their responses has been recorded and shared.

**Table 2: Recorded Responses from a no. of samples**

3. Questions asked	Percentage of responses (Yes) %	Percentage of responses (No) %
Q1. Have you heard about e-waste?	23	67
Q2. Are you aware of green electronics?	35	55
Q3. What do you think about recycling of materials?	46	44
Q4. Do you contribute for environment?	11	79
Q5. Do you check the tags like (recyclable or not) on packets at the time of purchase?	12	78
Q6. If products are not recyclable, do you purchase them?	32	58
Q7. How often you found recyclable products in shopping?	30	60
Q8. Would you like replace your products into recyclable products in future?	15	75
Q9. Have you heard the term incineration, landfilling?	10	80
Q10. Do you use, bio degradable products in daily routine life?	20	70

These responses have been recorded from all 90% people who took participated in survey and read questionnaire. It can be clearly observed that not much of people are aware about green electronics and e-waste treatment methods.

### RESULT & DISCUSSION

From above survey conducted on randomly selected people, it is observed that people are less aware about recycling of e-waste. Some basic knowledge is found in around 25% of people regarding e-waste. Around 70% of the people are not using biodegradable products in their homes as per survey and very few people

(say 15% only) are willing to change their products and household things into recyclable products. Therefore, a lot of awareness and motivation is required to be shared with people on global level. Hardly, 10 people do persist some knowledge about landfilling and incineration, this shows that most of the people do not even know about how much e-waste is hampering the environment and nature. Medical waste is such a type of e-waste that, if not disposed of properly can cause, infectious serious health problems. After the conduction of the survey being analyzed, a short seminar had been conducted in order to share basic knowledge with people participated telling them how e-waste can be controlled and reduced.

### CONCLUSION AND FUTURE PERSPECTIVE

It can be concluded from above study and survey experienced, that more and more information is required to be shared with citizens to make them aware about how to reduce e-waste. A green movement should be conducted on social platform to motivate people to purchase only recyclable products then only the e-waste can be controlled. Some major points should be issued by government as well in favor of citizens such that purchase only recyclable products. If people are using non-recyclable then also, aims towards proper disposal of those products. Giving those items to social workers and NGOs that works creatively to modify them into some form of useful products. In order to control the amount of generation of waste as well as for reducing already present, people need to think over it on a serious note and should take some productive and integrated steps that may results in environment friendly consumption of resources and less amount of e-waste will reduce the burden on planet. Thus, preventing the causes of serious health problems as well.

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