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# A Sustainable E-waste Management System and Recycling Trade for Bangladesh in Green IT

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**Abstract.** E-waste is the electrical waste that we decide not to use anymore or don't want anymore. The most disappointing thing is that we can hardly recycle only 10% of electronic garbage globally. Now, what about 90% of the waste? Unfortunately, 90% of the waste we do not recycle, or we can not, and that 90% causes huge damage to the whole world. Recycling is needed because Toxic chemicals such as lead, and chromium can be found in many outdated electrical gadgets. Also, some examples are mercury, cadmium, and beryllium. These chemicals seep into the soil when e-waste is thrown into landfills, damaging both the groundwater and the air. A lot of recycling business models exist but we have tried to develop a sustainable recycling process business model by analysis. We have gone to two companies and tried to know their business process model also we have collected some data. We have tried to implement our business process model. As we have said our goal is to make a sustainable business process model so our system is also capable of trade for Bangladesh in green IT. This paper assists the reader in learning about e-waste management and the recycling process, as well as how they interact during the activation process.

**Keywords:** E-waste · Sustainable recycling · Green IT · Industrial infrastructure · Renewable energy

## 1 Introduction

In recent years, Bangladesh has indicated rapid economic expansion with customers' rising market for electricity and electronic machines. Electronic trash has been generated because of population growth. Electronic waste is defined as electronic devices, mobile phones, and entertainment items like televisions and refrigerators, whether discarded by their owners. E-waste generates when an electromagnetic product reached the end of its life. [Wikipedia] Dhaka and other major Bangladesh cities produce thousands of tons of electronic waste each year. The COVID outbreak also expanded the use

of information technology (e.g., online meetings, school, shopping, etc.). Thousands of people work in the informal sector, which recycles up to 97 percent of its total. Processing techniques include cleaning, melting, and burning. Any security precautions are simply ignored by these workers. Acids are used to extract precious metals from these operations, but they also pollute the environment by releasing dangerous metals like lead, cadmium, mercury, chromium, and other poisons. E-waste recycling done incorrectly produces significant hazardous emissions, which have substantial health and environmental effects. The informal recycling process is linked to occupational health risks for E-waste pickers and users, along with community health risks for the local population management of E-waste. As a result of e-waste management improperly, employees are directly associated with many health concerns, while people are indirectly exposed to the danger of contamination (air, water, and soil). The circular economic growth main principle of sustainable e-waste management provides several options. Developed countries export most of the electronic waste to emerging countries. Of all the waste sources such as IT & Telecom and home appliances, home appliances refrigerators are the most wasteful compared to other equipment. Shortening the life cycle of electronic products such as computers, laptops, and mobile phones produces large amounts of e-waste in developed countries such as North America. Now let's see why e-waste management is so important. It is important to keep e-waste out of landfills. The EPA has determined that waste is dangerous if disposed of improperly. Electronic devices contain toxic substances and heavy metals. Substances such as chromium, cadmium, mercury, and lead can seep into the soil and pollute air and water. Each year PA estimates that approximately 60 million tons of e-waste are generated worldwide. Recycling this material saves landfill space. For these reasons, there are currently many state laws prohibiting the dumping of waste. Bangladesh is developing with a developing business sector for buyers of home machines and electric and electronic devices. These requests have made a situation of expanding measures of privately created hardware items and expanding interest for re-utilizing these items. Hardware is to a great extent restored and reused in semiformal and casual areas. Reusing of supplies and as well as unloading are making risks nowadays. These electronic squanders could cause ecological and well-being dangers. As of now, there is a need for mindfulness and satisfactory data hole on e-squander dangers in Bangladesh.

This paper aims to focus on analyzing the present recycling process of e-waste and raise awareness about its environmental significance. In this project, our focus is to find a recycling process from the existing processes that will be sustainable and make a profitable recycling trade. In our country, there will not be any fully recycling companies. One company is always dependent on other companies for recycling some materials. We are trying to find a sustainable business process model so that every company will benefit, and the amount of e-waste will be decreased.

We have tried our best but there are two limitations which are we cannot do our work properly with all kinds of e-waste material, for this the environment is not fully filtered, so working with all kinds of e-waste is necessary and the other one is energy consumption. In the future govt help is needed.

Now, the research questions are:

- What are the efficient methods that will help reduce E-waste in Bangladesh?

In this country, a large proportion of waste generation comprises electronic waste. Electronic waste means cell phones, laptops, televisions, telephones, washing machines, air conditioners, printers, lights, some toys which are based on electronics, etc. E-waste contains different toxic materials, which are very dangerous. The manufacturing of these devices, as well as the use of rare materials, represents a significant source of embodied energy. As a result, we attempted to identify the most effective methods for reducing E-waste in Bangladesh.

- What are the solutions to reduce environmental problems because of e-waste pollution?

E-waste means electronic devices which do not work and is discarded. If this type of waste is not disposed of properly it can have major implications on human health and the environment. This type of gadget has dangerous substances in them, which can leak into the soil and water, poisoning both. If those pollutants find their way into our drinking water, it poses a health risk to ourselves and our families. So, we tried to find solutions to these huge problems.

- What are sustainable ways of recycling e-waste with business intent?

In our country, only a small percentage of obsolete electronic devices are properly recycled while everything else ends up as garbage and thrown away. Not disposing of these objects properly can have dire consequences for the environment. Dismantling crudely can often result in toxic emissions, which contaminate the environment and expose workers and the public to hazardous pollutants. Many valuable metals, including gold and silver, can be found in this e-waste. So, we tried to figure out how to recycle E-waste in a business-friendly way.

In this paper, we try to focus on sustainable e-waste management and recycling trade for Bangladesh in green IT. To do that, we need to satisfy the following objective.

**Analyzing Sustainable Recycling Process:** For this project, we intend to analyze a sustainable recycling method based on existing procedures. We strive to go through as many recycling processes as possible. Through analysis of all types of existing procedures, we try to find the most sustainable recycling process.

**Profitable Trade:** Our goal is to make it a successful trade for Bangladesh after discovering a sustainable recycling process. The advantages of a circular economy are self-evident: recycling protects the environment while conserving raw materials. However, the system can only deliver such benefits if recycling companies are profitable.

## 2 Related Work

- E-waste recycling assessment at university campus: a strategy toward sustainability: E-waste disposal affects people from all walks of life. As a result, the sustainability of E-waste with the three pillars of environmental, economic, and social sustainability is major [1, 2].



- Reusing and Recycling Practice of E-Waste in Some Major Cities of Bangladesh: Electronic hardware reuse and recycling can result in a variety of environmental, social, and economic benefits. This study contributes to and ascertains the present ability of E-waste handling and its management within the selected areas of Dhaka, Chittagong, and Mymensingh City Corporations, as well as the Munshigonj district [3].
- Sustainable management of electronic waste: Empirical evidence from a stakeholders' perspective: Due to the incredible advancement of the current era various devices are being used and discarded daily which is the main cause of the increasing rate of E-waste. Because of this phenomenon, the rate of growth of E-waste has increased exponentially. It is considered very harmful and dangerous, if not disposed of properly [4].
- E-waste management in Bangladesh (an overview): The growth of electronic waste in Bangladesh is expected to reach 15% between 2020 and 2025, which is a significant increase. Bangladesh recycles a very minor portion of the total amount it generates due to a lack of smart waste management solutions. The massive increase in e-waste can seriously degrade environmental quality, putting both human and marine life at risk [5].
- A Systematic Review of E-Waste Generation and Environmental Management of Asia Pacific Countries: This paper shows a review of the existing electronic-waste management processes. The focus of this paper is e-waste management countries such as Australia, China, India, Indonesia, and Malaysia. There was a total overview, and progress recommendation [6].
- Electronic Waste (A Growing Concern in Today's Environment): It shows the rising of electronic things and the rising of E-waste. Also some talk about microprocessors that will be used [7].
- An investigation of trends in precious metal and copper content of RAM modules in WEEE (Implications for long-term recycling potential): The precious metal (PM) and copper content of dynamic-RAM modules sold between 1991 and 2008 was determined using AAS after comminution and acid digestion. Linear regression analysis of compositional data ordered by sample chronology was used to identify historic temporal trends in module composition caused by changes in manufacturing practices, as well as to project future trends for use in a more accurate assessment of future recycling potential [8].
- Assessment of air pollution caused by illegal e-waste burning to evaluate the human health risk: This paper is all about air contamination levels and chemicals also the reusing of all kinds of e-waste [12].
- Experimental investigation of pyrolysis of printed circuit boards for energy and materials recovery under nitrogen and steam atmosphere: In this review, steam climates and pyrolysis of printed circuit boards in idle have been examined as an important elective for energy recuperation of the natural division with concurrent reusing of metals [11].
- E-waste Management (A Study on Legal Framework and Institutional Preparedness in Bangladesh): This review targets surveying the ongoing status of e-squander executives and proposing a strategy structure for further developing e-squander executives in Bangladesh [9].

- Assessment of Generation of E-Waste, Its Impacts on Environment and Resource Recovery Potential in Bangladesh: Bangladesh, incongruity with the worldwide pattern and because of its continuous fast development, is moreover utilizing gadgets-based apparatuses, hardware, and devices at a rising rate, in individuals' homes, workplaces, modern unit, vehicles, and correspondence frameworks. This has caused a relating expansion in the pace of age of e-squander [10].
- E-Waste Management Strategies for Implementing Green Computing: This paper centers around the depiction of e-waste on the board for carrying out green figuring. This paper assists the peruse to get information about-squander the executives and green figuring and how they can impact each other in the actuation interaction [1].

### 3 Materials and Method

Our goal is to create a more sustainable E-waste recycling model which is better than the one currently being used. To that end, we have visited two companies that work in this field. The first one we visited was "Yousuf Enterprise". This company was established in the year 2012. It is situated in Badda. The second that we visited was "Azizu" this company was established in 2006. It is situated in Narayanganj. There we discussed it with the owner (boss) and a few staff members. They helped us to collect all the necessary information by answering most of the Questions we had for them.

Here we give detailed explanations of the companies and their methods. We also made a diagram from the info we gathered on both the companies afterward we voiced our innovations by understanding and comparing both companies' information.

#### 3.1 Yousuf Enterprise

Yousuf enterprise (Fig. 1) was established in 2012. What they do is collect E-waste from different companies (Network companies, laptop companies, mobile companies, etc.). These companies hold a tender for their E-waste and many E-waste recycling companies bid for it, whichever company is selected can take the position of the E-waste and ship it to their warehouse. There they start to separate the waste such as laptops, mobiles, etc.

Now it's time for the dismantling process but even before starting this process, some various legal steps and permissions need to be fulfilled. First, they need permission from BDRC and probes to push the E-waste. Afterward, they must have at least one member of BTRC, Porites, the local police station, NSI, DGFI, the company who sold that E-waste, and of course the company who will be recycling it.

After gathering all these people in one place, the process of dismantling starts takes a long time; it can take up to three to four months for one shipment to be dismantled and fully recycled. The people mentioned above must be present at the start of the dismantling process and present at the end of this process.

After finishing the dismantling process, they start to separate the components such as motherboard/circuit board, raw plastic, and different types of metals. After finishing the dismantling process there are still the raw materials from two different mills based on the material.

The motherboard/circuit board is exported (sold) to foreign countries mainly Japan and Malaysia.

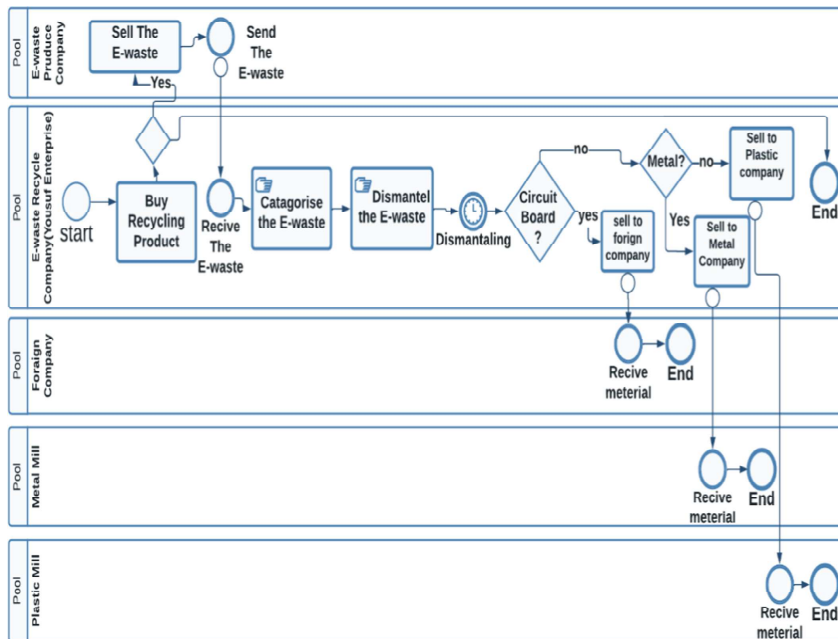


Fig. 1. Business process model of yousof enterprise

### 3.2 Azizu Recycling and E-Waste Company

They can recycle the finished product of electronic waste, but they cannot 100% recycle this electronic waste. Azizu (Fig. 2) was a recycling management company then in 2014 they started a recycling plant in their company. They collect e-waste from telecom companies, offices, garments, etc. After collecting the electronic waste, the process of recycling is dry, they use zero landfill, and minimum burn gets suctioned, no water or chemical treatment melting process. They all do this with the permission and guidelines of BTRC. The main motivation for them is green Bangladesh.

They mainly use the melting process and electrolysis process so that they get from PCB metals and non-metallic parts. In this PCB's metals, there are 17 types of metal and in this non-metallic part, there are three types of fire-resistant plastic. And another thing in this metal 95% is copper. They melt them and make sheets. In the non-metallic part, there are three types of plastic. They export these metal and non-metallic materials. They have a partner in Singapore. They don't get enough electronic waste so they are just surviving, and they cannot get much profit from it.

After recycling they give certificates to those companies where they collect e-waste from. This certificate is proof that they destroy these electronic wastes environmentally.

They cannot recycle batteries because they don't have a battery recycling plant and government permission. They export the batteries.

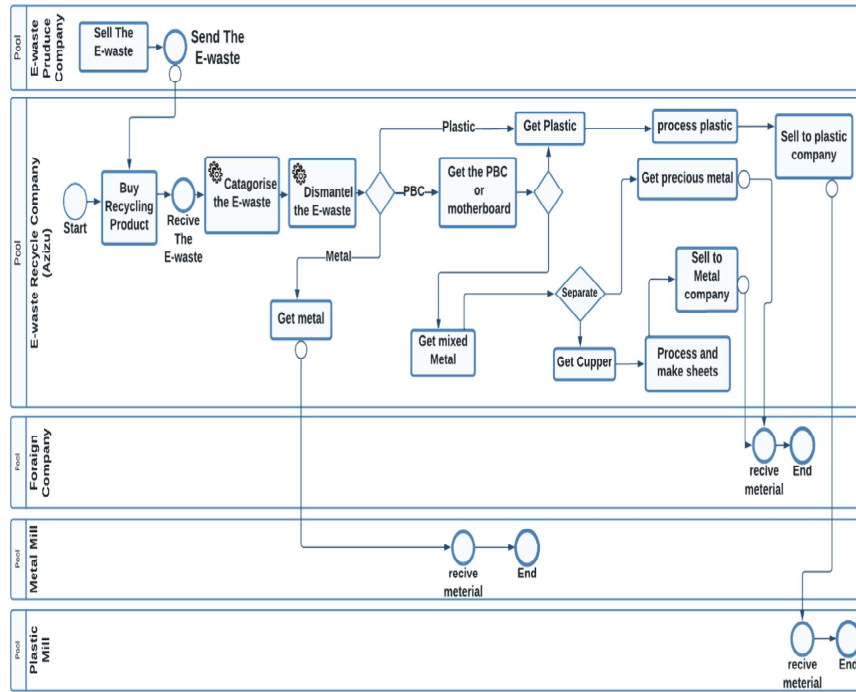


Fig. 2. Business process model of azizu recycling & E-waste company

### 3.3 Proposed Method

We proposed a method (Fig. 3) that will help to become this e-waste recycling process more sustainable and environmentally friendly. These two companies, cannot do 100% recycling. So that we try to make it sustainable and environmentally friendly. in the recycling process, we used many machines which will help to dismantle and melt the electronic waste. These machines need huge energy, this energy is coming from electricity. So, we are using solar panels or renewable energy to run these machines so that it will help to make it more sustainable for the company. We need to establish solar panels and Wind turbines for renewable energy. This energy will help to run recycling companies by their power. It will be greener for the environment.

To extend the business and profit more, we must open a valuable metal extraction plant in the recycling company. so that we do not have to sell that raw material in other countries. We can extract the gold, silver, copper, and many more valuable metals from electronic waste and sell them to many companies in our country or export them, it will be more profitable.

## 4 Results and Discussion

In our project, we find a sustainable and environmentally friendly recycling process. We propose solar panels that generate energy for the machines. This energy will help to run recycling companies on their power. It will be greener for the environment.

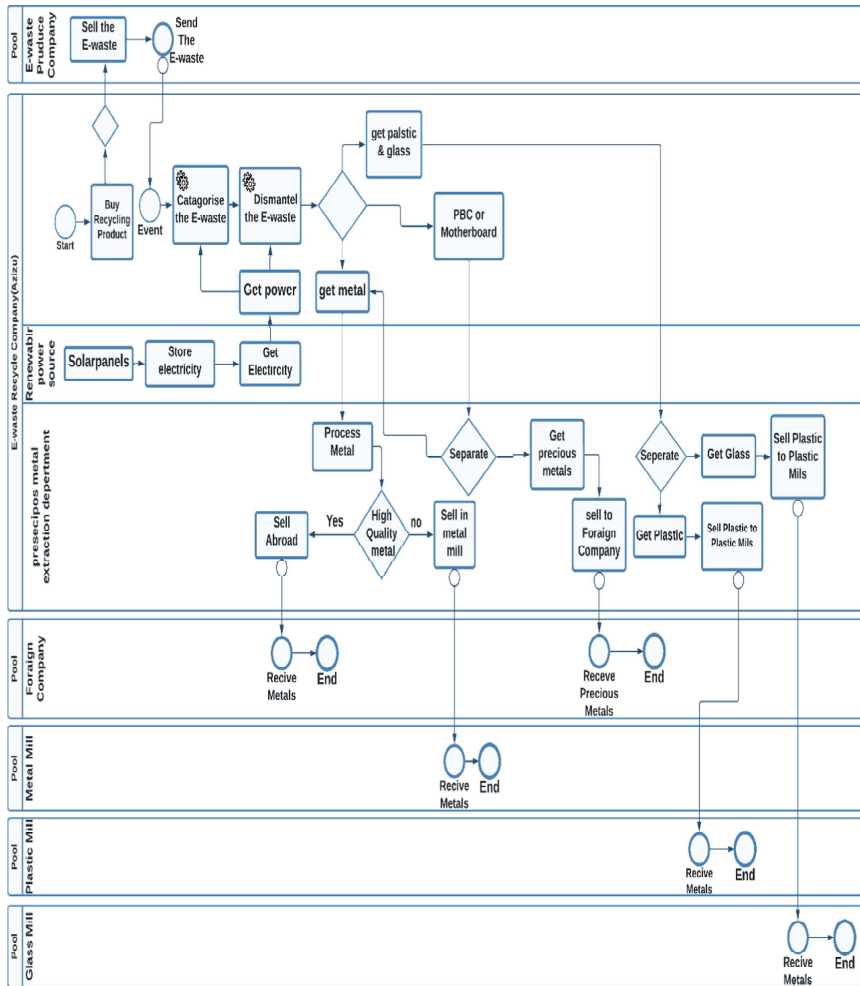


Fig. 3. Proposed model

If 5 tons of e-waste are recycled per day.

Then in a year  $5 * 365 = 1825$  ton.

For 10 h of use, the recycling machines have 645 kWh of electricity needed.

Bangladesh electricity prices in Business = 8.990 Taka/KWh.

So,

per day electricity cost = use of electricity (kWh) \* electricity price kWh

$$= (645 * 8.990) = 5798.55 \text{ Taka.}$$

To recycle 5 ton of e-waste need 645 kWh.

To recycle 1 ton of e-waste need  $645/5 = 129$  kWh.

To recycle 1825 tons of e-waste needs  $1825*129 = 235425$  kWh.

$$\begin{aligned} \text{The cost for a year} &= \text{use of electricity (kWh)} * \text{electricity price kWh} \\ &= (235425 * 8.990) = 2116470.75 \text{ Taka.} \end{aligned}$$

Now, by using a 1.6 square meters solar panel, during a normal summer day we can get up to 10 h of sunlight. From this, we can ascertain that it creates 3000 watts or 3 kWh per day.

Using 250 solar panels we can get  $250 * 3 = 750$  kWh of electricity per day.

So, per year we can get up to  $750 * 365 = 273750$  kWh of electricity.

1 good quality industrial solar panel price in Bangladesh is approximately 5000 Taka.

For the need of 250 solar panels need  $250 * 5000 = 1250000$  Taka.

And for the whole solar system need approximately 1500000 Taka more.

So total cost will be  $1250000 + 1500000 = 2750000$  Taka approximately.

The solar-panels life span is limited. It is about 25–30 years.

So, the basic cost of electricity in the recycling companies will be close to zero for 25–30 years after the installation of the solar panels. This is much more efficient for an e-waste recycling company.

In our proposed method, we propose different departments for the processing of metal and plastic. As a result, the processing time will be decreased, and the processing ability will be increased. On the other hand, in our proposed model, companies don't need to sell raw materials to other countries if they have the method of extracting materials. They can sell the valuable materials to other companies in our country. It will be more profitable because they don't need to sell these at a cheap price.

## 5 Conclusion

The management of E-waste is currently one of the biggest challenges in our country. Our country has a high population density. Although the countries have inexpensive labor, they have little land. Electronic trash, on the other hand, contains hazardous materials. If e-waste is not properly managed, there is a significant risk of damaging the environment. When e-waste is recycled, it puts recyclers' health in jeopardy. We can take some action to handle e-waste and make the e-waste management sustainable like electronic waste inventory in Bangladesh's major cities, setting up an efficient collection process for at least some electronic garbage, tracking e-waste trafficking and transport-waste also requires treatment, and recycling is expensive. For its safe management, qualified staff and advanced technologies are required.

[AQ1](#)

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