

Forecasting of Potential Electronic Waste in Guwahati

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ABSTRACT: Electronic waste (E-waste) or waste electrical and electronic equipment (WEEE), though a recent addition to the hazardous waste stream, is drawing serious attention across the world. E-waste is a popular term used for all electronic equipment which has completed their useful life. The exponential growth of electronics industry, change in fashion, change in technology, increasing consumption rates are a few causes attributed to the accumulation of e-waste in huge amounts. But, the necessary rules and regulations regarding e-waste management are not being employed. Thus, an estimation of the amounts of e-waste generated has become crucial. Considering the data collected by the authors on selected electronic equipment, the paper tries to calculate the amount of e-waste accumulated in the last few years in for Guwahati, a city in the north-eastern Indian state of Assam. It also predicts the amount of e-waste to be accumulated in the upcoming years. It has been found that the total e-waste accumulated in Guwahati in 2016 is 16.72MT and is expected to rise to about 22.60MT by 2020.

KEYWORDS: E-waste generation, electronic equipment, obsolescence rate, sales, forecasting

I. INTRODUCTION

The rapid innovations in technology have transformed the way we live, work and communicate, thereby bringing numerous benefits and made our lives easier than it has ever been. But on the other hand, development of technology, the rise in per capita income of people, increasing longevity of electronic items have also led to huge amounts of waste generation, popularly known as electronic waste (E-waste). The E-waste is one of the fastest growing waste streams in the world. E-waste comprises of waste produced from the used electronic devices such as computers, hand-held cellular phones, personal stereos; large household appliances such as refrigerators, air conditioners etc. and are nomore suitable for their intended use and should be recovered, recycled or disposed of. It takes place due to the increase in “market penetration” in developing countries, “replacement market” in developed countries. The scenario in India is the same. It has been estimated that India generated around 4 lakh tonnes of electronic waste in 2010 increasing year-by-year from 1.47 lakh tonnes in 2005. Like solid waste, the waste management system for E-waste is not satisfactory. It is managed through various low-end management alternatives such as product re-use, conventional disposal in landfills, open burning, and backyard recycling like any other developing country. Thus, there is a need to create an efficient waste management system by the recovery and reuse of useful materials from the waste, reducing the harmful substances from the waste intended for final disposal to meet the environmental and sustainability norms.

The main sources of electronic waste in India are the Government, Public and Private sectors, which sums for almost 70 % of total waste generation. Household appliances contribute about 15% to the total waste generation. The electronic waste consists both useful and harmful substances. Typically, E-waste contains metals (40%), plastic (30%), and refractory oxides (30%). The metal scrap consists of copper (20%), iron (8%), tin (4%), nickel (2%), lead (2%),

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zinc (1%), silver (0.02%), gold (0.1%) and palladium (0.005%). Plastic components are polyethylene, polypropylene, polyesters and polycarbonates.

The electronic waste, in addition to solid waste, has started to create huge problems for Guwahati. Guwahati is located in the north-eastern state of Assam in India and is termed as the commercial hub of the north-eastern India. As the city has to deal with an ever increasing population which uses a large number of electronic items, the city automatically creates a huge amount of obsolete electronic items, thereby producing e-waste which is a grave concern for the city. Moreover, there is no proper treatment and disposal system of the waste produced in the city. Improper disposal or contact with e-waste can lead to contamination of the surrounding ecosystem and prove to be a major health hazard. Also, land filling of e-waste can lead to the penetration of heavy metals in ground water. Thus, it becomes critical to know the amount of e-waste that will be generated and when it will be generated, so that an appropriate infrastructure can be established (Kang and Schoenung 2006). Presently, the government agencies have very fewer data regarding the current quantity of the e-waste generated in Guwahati. Therefore, the main objective of this study is to estimate the e-waste accumulated by collecting the sales data of the selected electronic items, their weights and obsolescence period so that proper steps can be taken for its treatment, disposal and handling problems; identify the major generators and assess the risks involved. Since electrical and electronic products are of such a wide range of varieties, it would become very complicated to assess all the electronic items. Thus, the paper chiefly deals with waste generated by four most commonly used electronic items viz. Laptops, Desktops, Cellular Phones and Printers.

II. LITERATURE REVIEW

The components of E-waste are divided into three categories:

- 1) Household Appliances---e.g. refrigerator, washing machine
- 2) IT and Telecom---e.g. personal computer, laptop, cellular phone
- 3) Consumer Equipment---e.g. television

E-waste concern in Guwahati is crucial because of the large volumes of obsolete electronic products generated contain toxic materials like Lead, Mercury, Bromine, Cadmium, Sulphur, etc. which are precarious to both human health and the environment. Electronic wastes can cause widespread environmental damage due to the use of toxic materials in the manufacture of electronic goods (Mehra, 2004). The cadmium from one cellular phone battery is enough to pollute 600 m³ of water (Trick, 2002). The quantity of cadmium in landfill sites is significant, and considerable toxic contamination is caused by the inevitable medium and the long-term effects of cadmium leaking into the surrounding soil have been witnessed (Envocare, 2001). The lack of awareness, ever escalating use of electronic products, can potentially damage the fragile environment. Also, the absence of any recycling and disposal system in the city adds up to the equation.

Both the Formal Sector and Informal Sector are considered to be the main sources of e-waste. The Formal Sector includes Importers, Manufacturers, Retailers (business/government), Consumers and Scrap dealers, whereas the Informal Sector includes Dismantlers, Smelters and Recyclers (Borthakur and Singh, 2012).

Electronic Waste Management in Guwahati:

A comprehensive study was conducted by authors on the existing system of e-waste management in the city. The study gives an impression about the present e-waste practices of the various participants in the system.

Informal Sector:

The rag pickers maintain the electronic waste flow as they collect most of the obsolete electronic products in the city from household and manufacturers. The items collected by the rag pickers end up in the hands of informal recyclers. The e-waste produced in small and medium sectors end up with the informal recyclers where recycling is done in a risky way.

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Vol. 6, Issue 3, March 2017

Also, waste traders with better financial capacity, who bid for larger volumes of waste that are discarded by companies and organization through auctions. The waste then flows down to the scrap dealers. First, they dismantle the e-waste into different components; collect useful components and the other waste are thrown in open land or the Boragaon dump site.

Formal Sector:

The Formal sector has the scope of better and more organized management practices. It requires the joint efforts of all the stakeholders including producers, domestic users and consumers so that an efficient management, disposal and recycling structure can be carried out. The Government of India ordained rules to replace the Informal Sector by the Formal Sector. Many recycling companies have evolved in India which has been granted approval by the concerned Pollution Control Boards.

But the situation in Guwahati is very gray. Few formal e-waste collecting centres are available in the city. The registered e-waste drop points in Guwahati are:

- 1) Redington India Limited
- 2) Carrier Media India Pvt. Ltd.
- 3) Zebrionics India Pvt. Ltd.
- 4) Bir Electronics Pvt.Ltd.

According to the Assam Pollution Control Board, about 23.274MT (metric tonnes) of e-waste was collected by the e-waste drop points all over Assam in 2014. The collected wastes were sent for recycling to Bangalore (Karnataka), Roorkee (Uttarakhand) and Hoogly (West Bengal).

Government:

In view of the growing amount of e-waste, the State Government is planning to implement a project for disposal, including recycling of the e-waste materials generated in Assam. A survey was conducted following this and as per a preliminary survey report, a quantum of 50 MTs of e-waste materials was found available in the surveyed areas. The survey was conducted in Assam Petro-Chemicals Ltd. (Namrup), BVFCL (Namrup), Dibrugarh University, ONGC (Jorhat), Jorhat Engineering College (Jorhat), OIL (Duliajan), IOCL (Digboi), ONGC (Sivasagar) IOCL (Bongaigaon), Army Headquarters (Tezpur), Air Force Station (Tezpur), Tezpur Central University, Assam Engineering College (CSE Dept), and a few offices of the Deputy Commissioners of the State. The Deputy Commissioners of several districts and leading institutions having e-waste materials have been contacted and requested for giving complete statistics of their e-waste generation. The proposed e-waste plant will have integrated e-waste recycling and treatment facilities for minimizing the hazards. The proposed site for the e-waste plant is in Chandrapur (The Assam Tribune, Feb 2014).

Thus, it is quite evident that the electronic waste management system in Guwahati is not satisfactory. Proper planning and execution of the plans have to be done in order to mitigate the rising hazard. It is the responsibility of government as well as citizens to do the methodical e-waste management and disposal.

The authors used linear regression to forecast the sale values of a few selected electronic items for upcoming years and then computing the amount of e-waste that will accumulate in those years. The method used for future prediction of the sales is the Forecast function provided in Microsoft Excel. This method is defined to calculate, or predict, a future value by using existing values. The most common applications of this function are to predict future sales, inventory requirements, or consumer.

III. APPROACH AND METHODOLOGY

Collection of sales data:

The authors have used the Market Supply Method to determine the collection of e-waste in the city. This method was first used in Germany for the calculation of e-waste. The market is first analysed and the different stores with premier sales in Guwahati city are considered. The authors were able to collect the sales data of the selected electronic items viz. laptop, desktop, cellular phone and printer from the stores for the period of 2009-2016.

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 6, Issue 3, March 2017

Average weight of the selected items:

The average weights of all the items are also taken into account. The average weight of laptop, desktop, cellular phone and printer is taken to be 3.50 kg, 27.20 kg, 0.130 kg (130 g) and 2.73 kg respectively.

Obsolescence period:

Obsolescence period is the time after which anything becomes unusable or unfashionable. The average obsolescence period of all the selected items is considered in accordance with the Indian scenario. The obsolescence period for laptop, desktop, cellular phone and printer are considered as 4 years, 5 years, 2 years and 4 years respectively.

E-waste estimation:

The contribution of any obsolete electronic product to the e-waste production can be estimated using the equation (Robinson, 2009):

$$E = \frac{MN}{L}$$

Where:

E is the annual e-waste of a certain electronic item (kg/year)

M is the mass of the selected item (kg)

N is the number of items

L is the average lifespan of the item (years)

Method used for e-waste forecasting:

The tool used for future prediction of sales of the selected electronic products for the upcoming years is Microsoft Excel. By using regression analysis, a trend-line is developed beyond the actual data to predict future sales value. From the predicted sales value, the amount of e-waste to be accumulated in Guwahati by 2020 is evaluated using the equation as described above.

The paper assumes that there is no loss and no conversion of material has taken place in the consumption period.

IV. RESULTS AND DISCUSSIONS

Using the forecast technique, the amount of e-waste which will accumulate in the upcoming years (till 2020) have been estimated. Table 1 gives the detailed estimate of the potential e-waste generation in the upcoming years in Guwahati. Figure 1 is a graph distinctly showing the individual contribution of laptops, desktops, cellular phones and printers in generating electronic waste in the upcoming years. A steep increase in e-waste generation by the laptops can be attributed to its increasing sales in Guwahati. Increasing trends are also observed in the waste generated by cellular phones and printers due to their increasing usage and demand. A decreasing trend has been observed in the waste generation due to desktops as the sales of desktop in the city are reducing due to its obsolete nature. Also, the highest sale is observed in cellular phones but as its weight is very less compared to the other equipment, its contribution in e-waste has been the least.

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Table 1: Predicted e-waste in Guwahati

Year (s)	Electronic Waste (MT/year)				Total (MT/year)
	Laptop	Desktop	Cellular Phone	Printer	
2014	2.49	7.82	1.44	2.86	14.61
2015	2.97	7.53	1.54	3.16	15.20
2016	4.61	7.33	1.67	3.11	16.72
2017	5.84	7.20	1.81	3.19	18.04
2018	7.41	7.38	1.89	3.27	19.95
2019	9.40	7.24	2.01	3.34	21.99
2020	9.88	7.10	2.12	3.50	22.60

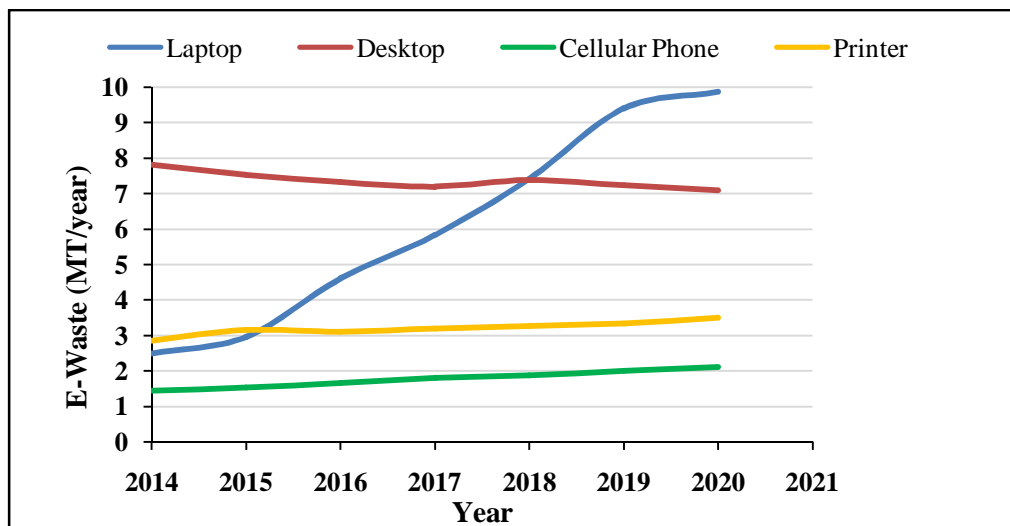


Fig. 1: E-waste prediction of different electronic products in Guwahati

Figure 2 shows the relative electronic waste generation trend for all the four equipment from 2014 to 2020. Here it is seen that the e-waste accumulated due to desktops are gradually decreasing in consequent years whereas, e-waste due to laptops are increasing in the highest rate. This can be attributed to increasing sales of laptops in the present day. Also, e-waste due to both cellular phones and printers are also of escalating nature.

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 6, Issue 3, March 2017

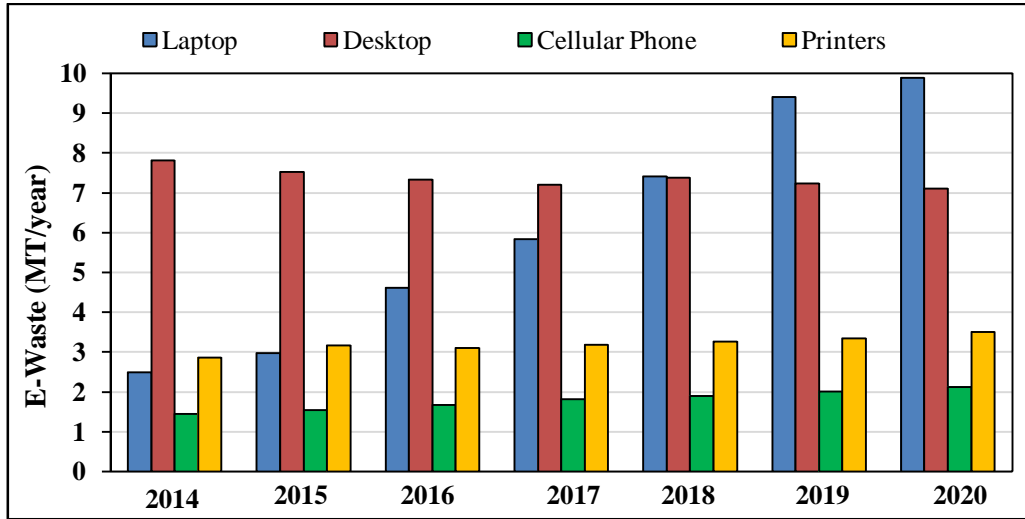


Fig. 2: Yearly relative variation in e-waste generation

Figure 3 shows rising tendency in the total amount of potential e-waste to be generated in the upcoming years by the four electronic equipments in the city of Guwahati. From our study, we found that the total amount of e-waste will increase from 16.72 MT in 2016 to 22.60 MT in 2020. Thus, a 35% rise is expected in the amount of e-waste collected in the upcoming 5 years in Guwahati.

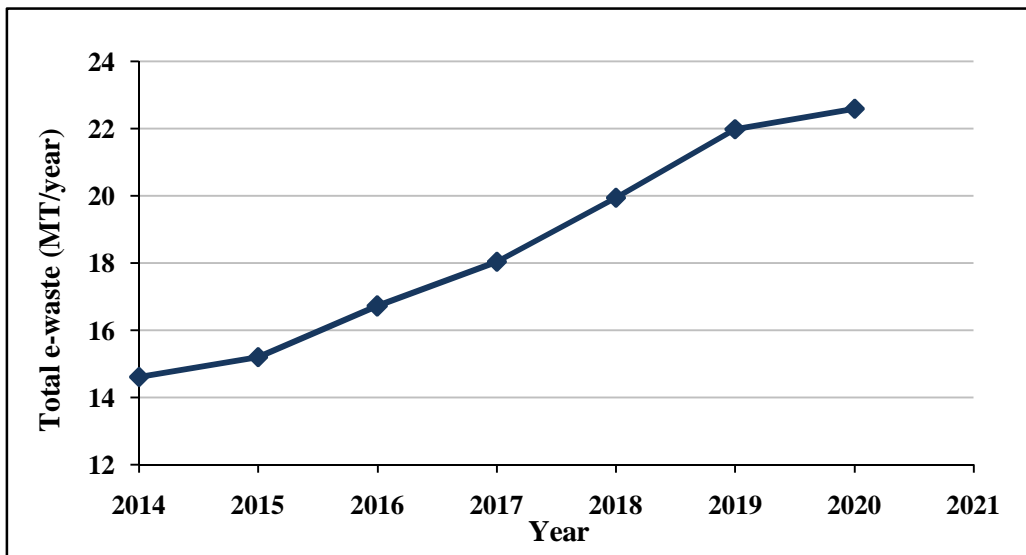


Fig. 3: Total e-waste projection in Guwahati till 2020

International Journal of Innovative Research in Science, Engineering and Technology

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Vol. 6, Issue 3, March 2017

V. CONCLUSION

This paper is an effort to predict the rate of generation of e-waste in Guwahati in the upcoming years. The results of the study indicate that the estimation of e-waste generation in Guwahati is considerably dependent on sales data and the average life span of electronic items. The paper estimates that with this increasing consumption trend, the total amount of e-waste in the city would be 22.60 MT in the year 2020. This raises the need of conducting a thorough study of consumer behaviour. During our study, we found that most of the people in Guwahati are ignorant of the various hazards associated with electronic waste. Also, the Government along with a few organisations have failed in creating an efficient waste management system. Most of the e-waste collected is being dumped along with the solid waste in the Boragaon dumping site by the Municipal Corporation. Thus, there is a serious need of an efficient system to tackle the rising problem of electronic waste generation. The authors believe that a combined effort by the policy makers, various organisations, the informal sector and the concerned citizens will surely lead to an efficient system to restrict and manage this growing menace in Guwahati city.

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