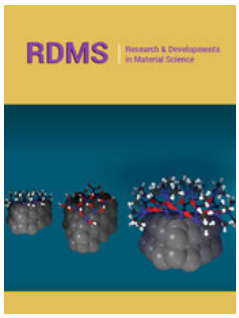
Crimson Publishers
Wings to the Research

Review Article

Egyptian Perspective of Electronic Waste

ISSN: 2576-8840



Ghada A Abdel Aziz and Sherine M Abd El-Kader*

Electronics Research Institute, Cairo, Egypt

***Corresponding author:** Sherine M Abd El-Kader, Electronics Research Institute, Cairo, Egypt

Submission: September 15, 2023
Published: October 03, 2023

Volume 19 - Issue 4

How to cite this article: Ghada A Abdel Aziz and Sherine M Abd El-Kader*. Egyptian Perspective of Electronic Waste. Res Dev Material Sci. 19(4). RDMS. 000966. 2023. DOI: 10.31031/RDMS.2023.19.000966

Abstract

As the electronic devices production is increasing rapidly and the electronic industry grows exponentially, thus, the problem of e-waste increases all over the world. In this paper, the Egyptian perspective of electronic waste (e-waste) is discussed. The key reason behind uncontrolled e-waste in Egypt is the rapid development of innovation along with low production cost. As a result, huge amounts of e-waste are needed to be discarded every year whose disposal is a foremost concern. For tackling this problem of e-waste, e-waste management techniques such as recycling along with reducing play a significant role. These techniques also assist in establishing a circular economy. This paper introduces a statistic questionnaire on the generated e- waste in Egypt, along with presenting the paper recommendations for the e-waste issue.

Keywords: Waste electrical and electronic equipment; E-waste; e-waste collection

Introduction

Due to the rapid requests for electronic products and their fast consumption among consumers, these products become after the end of their useful life and if not needed, consumed or damaged, they become waste as indicated in Figure 1; [1]. These electronic wastes are defined as the waste of electrical and electronic equipment (WEEE), and waste electrical and electronic equipment can be defined as any product or part of it that has been disposed of because it is no longer useful or desirable after the completion of its use [2]. It also includes the remnants of production processes and processors, which are also the product of depreciation of equipment, devices, electronic and electrical products after the end of their useful life and become unneeded, consumed or damaged, such as computers, laptops and their accessories that include (printer, digital camera, scanner) and tablets mobile phones, dry batteries, fluorescent lamps as well as large household appliances such as TVs, refrigerators, washing machines, air conditioners, microwaves, etc. [3].

Figure 1: The e-waste components.

E-waste consists of different electrical components made from a variety of materials mixed together. Materials that include e-waste include metals, non-metals, and ceramics, as well as some organic materials. Metals can be classified into ferrous and non-ferrous metals. Ferrous metals mainly include iron, nickel, copper and steel while non-ferrous metals are categorized into hazardous, precious and rare earth metals. Examples of hazardous metals found in e-waste are heavy metals such as chromium, mercury, cadmium, zinc, and lead while precious metals are classified as consisting mainly of gold, silver, platinum, and palladium. The rare earth metals present in e-waste are mainly talium, gallium, and tellurium [4].

The importance of e-waste recycling becomes clearer when we consider the harm that improper disposal of e-waste can cause. Electronic devices contain toxic substances such as mercury and lead. Therefore, if these devices are disposed of incorrectly, thus, these chemicals can cause harm to the environment. These chemicals are seeping into the air, soil and even water sources. In turn, this can have a harmful effect on humans, animals and plants.

Recycling the e-waste is of great importance in obtaining rare and precious metals to reduce the need to extract them from the ground, as it is a rich source of raw materials at the primary level, and thus natural resources will be preserved throughout the world. The United Nations has found that deposits of precious metals in e-waste are 40 to 50 times richer than those found in earth-based ore. So, recycling precious metals not only conserves the earth's resources, but is also more efficient [5].

The E-Waste Industry Size in Egypt

The Ministry of Environment, in cooperation with the Ministry of Communications, made an inventory of the e- waste sector in the Arab Republic of Egypt, and found that the total annual e-waste produced by Egypt is estimated at 88,000 tons annually, and this amount increases by 35% annually in Egypt, according to estimates by the US Environmental Protection Agency, and the optimum utilization of this waste has not been achieved, at a time when many Arab countries preceded in the field of recycling these wastes, which represent a neglected economic treasure [6].

The rate of e-waste recycling in Egypt does not exceed 15%, and the waste of Egyptians has reached more than 21 million tons. In addition to the presence of more than 20 garbage dumps, it has become a danger to Egyptians and their health, according to the Waste Management Regulatory Agency. In addition, we first need a general awareness and understanding that this waste has become a profitable commodity in all countries of the world, and that there are those who classify and purchase these wastes in order to recycle them, and that we should not waste what can bring us many gains.

Globally 50 million tons of e-waste is generated annually, according to the World Environment Organization, 30 million computers are controlled by computers, and only 15-20% of it is recycled. More than 75% of the toxic waste found in the world is electronic waste, according to the World Environment Organization, and it is worth noting that Japan manufactures about 60% of new electrical appliances using recycled electronic waste.

Some investors in the official sector of e-waste recycling, which are now 4 investors, have official and joint cooperation with the Ministry of Environment and have taken the advantage of the huge amount of waste that the Egyptian market produces, which is called the culture of consumption, but they still face many challenges as an attempt The informal sector and they are the largest segment that owns the largest amount of waste, and manipulates the market, so as not to reach them, in addition to the serious health, human and environmental damage that these wastes leave behind. In light of this, the ministry needs to activate the environmental register, in order to monitor and hold each facility accountable for the number of inputs and outputs in the elements arriving to it, and they need more studies, which in turn will fulfill their legitimate dream of establishing the largest factory that can absorb all waste, and its cost is estimated About one billion Egyptian pounds, on an area that may reach between 30,000 and 70,000 square meters [6].

E-Waste Recycling in Egypt

Egypt is one of the countries that lack policies and regulations dedicated to e-waste, and hence the Egyptian economy lacks economic capabilities, creating job opportunities to develop the e-waste sector and facing the great environmental and health challenges resulting from improper handling of the generated quantities [7].

Egypt has a great opportunity to recycle e-waste, and recover gold and precious metals from e-waste, which may generate approximately $100 million annually, as recycling nearly one million computers can provide electrical energy for more than 3,600 homes. Within a year. Also, when one million mobile phones are recycled, approximately 34 kilograms of pure gold, 3,500 kilograms of silver and 16 plus tons of copper can be recovered. These minerals, when obtained via the recycling process, will bring many funds to the Egyptian economy and will be much cheaper than extracting these minerals from primary ores.

A. E-waste collection in Egypt

E-waste collection process is considered the significant step in the electronic waste management. Without an effective collection system, any waste management system that relies primarily on recovering resources and precious metals fails.

The process of collecting e-waste is performed via the robabekias' sellers, as shown in Figure 2, as they collect them, whether at home or government institutions, resort to some of the e-waste from old mobile devices, TV screens, old computers, faxes, CD players. , cameras, printing machines, wireless and wired communication equipment, video equipment, household appliances such as microwaves, refrigerators, irons, medical devices, batteries, and lighting devices, by selling these wastes to street robabekia sellers.

Figure 2: Collecting the e-waste via the robabekias' sellers.

In the beginning, they estimate the commodity by some pounds when buying an old mobile phone by 2-3 EGP at most, or in the case of a computer screen at 15 EGP, as for the computer itself, it may reach 20 EGP, and the TV set its price ranges between 15 and 60 EGP, and as for the washing machine The price of the refrigerator may reach 150 EGP, and the price of the refrigerator may reach 200 EGP.

Al-Manawat area, Abu Zaabal, Umm Khenan, Al-Jabal Al-Ahmar, Al-Duwaiqa, Al-Arkasha, Ezbet Abu Hashish and Al- Zaraeb, are considered the most famous and important areas in which waste can be sorted, and then these wastes take two paths, either incineration, or they are transported to recycling factories that have machines, most of which are capable of local manufacture. After that, the collected waste is fed into a device that separates all the wefts from it, in order to leave each piece included in the installation separately. The price of this e-waste obtained by these factories after sorting them ranges between 3 thousand Egyptian pounds per ton and 12 thousand Egyptian pounds, each according to its type and the amount of minerals in them, which can be extracted from these wastes [8].

B. E-waste recycling factories in Egypt

Since the e-waste recycling project is one of the high-profit projects, in addition achieving great income for its owners in a short period, and since this field is considered a service work for preserving the environment, it soon gradually turned into a huge commercial project.

The Minister of Environment confirmed that Egypt, at the level of the governorates of the Republic, there are 44 factories for waste recycling of all kinds of solid, electronic and organic, including 74 lines, including about 4 official factories specialized in recycling electronic and electrical waste and lead batteries.

It is planned to establish 14 new lines to raise the efficiency of 56 lines within four years through the budget for the fiscal year 2019/2020. Two lines are currently being constructed, the first in Sohag (Dar Al Salam) at a cost of 89 million Egyptian pounds, and the second in Minya (Tuna El-Gabal) at a cost of 45 million Egyptian pounds, in addition to raising the accumulations of land allocated for the construction of a new line in Mahalla Al-Kubra for preparing the construction drawings, at a cost of 89 million Egyptian pounds [9].

In Egypt, there are 12 factories and companies are working on the e-waste dismantling such as: Spear ink company, RecycloBekia company, the Egyptian Factory for Electronic Waste Recycling (EERC), Eco company, International Technology Group company, Green core company, Lead smelting, refining and manufacturing plant in Qalubiya, the Egyptian Company for Smelting, Refining and Manufacturing of Lead, the united battery company, the Chloride Egypt Company, the Egyptian Plastic and Electricity Industries (German Eagle), and the Nasiriyah center for hazardous waste treatment [9].

Proposed E-waste Management

Due to the massive increase in the quantities of e-waste daily, it has become an interesting problem on the global agenda, as there is a strong link between economic development and the generation of electronic waste. Because of the rapid urban growth rates with the exponential increase in the standard of living of citizens, these citizens are adopting a consumer culture. As a result of rising disposable income, technological progress increases rapidly, making the life cycle of products short.

Direct handling of e-waste is not only toxic to workers, but also the landfills where e-waste is stored have severe harmful effects on the surrounding areas. Many developed countries export a large portion of their e-waste to developing countries, where this waste is recovered using methods that are extremely harmful to humans and the environment. The e- waste can be effectively managed via fulfilling the following items (Figure 3):

Figure 3: Separation of the waste from the source.

1. Making awareness videos on social media about the dangers of e-waste.

2. Making awareness videos on social media on how to properly deal with e-waste.

3. Issuing brochures and posters to show the importance of electronic waste recycling and distribution in exhibitions and conferences.

4. Creating an appropriate environmental awareness about the dangers of burning electronic waste.

5. Establishing controls on the auction process in which electronic waste is sold from different parties and set standards for it.

6. Allocating vehicles equipped to collect e-waste.

7. Transporting the waste after its collection to the places designated for separation and division, in order to be recycled.

8. Setting standards in which e-waste is prevented from reaching the informal sector that operates with a selection policy, where it takes advantage of the parts that have value and benefit only and disposes of the harmful parts in an incorrect and unsafe manner, in order to benefit from the valuable devices only.

9. Designing an electronic application that aims to help families place their devices on it, in exchange for discount vouchers on some electronic device outlets.

10. Providing job opportunities for youth in all governorates through the correct and safe collection of electronic waste, and thus it will generate huge funds for the state and the owners of such waste.

11. Allocating a percentage of the recycling revenue to the residents and the neighborhood, as well as for the benefit of the general budget.

12. Develop a plan to train workers in the field of e-waste recycling, allowing work in small projects under the umbrella of a larger entity that results in a national industry in recycling such waste so that it becomes part of the formal economy and contributes to preparing qualified cadres to work in the field of resource extraction that benefit the state and countries Neighboring Africa.

13. Encouraging both medium and small companies to participate in e-waste recycling industries.

14. Establishing mechanisms for the safe disposal of electronic waste in the governmental and commercial sectors; And that is through coordination with the Central Bank for the governance of mechanisms for the disposal of old computers in the banking sector, and the National Telecommunications.

15. Regulatory Agency for the safe disposal of used communication devices with PABX and computers that contain electronic boards.

16. Adopting synthetic smart phones and iPhone Blocks instead of traditional phones, as these phones are more resistant, and certain parts of them can be changed, making them more environmentally friendly. E-waste will decrease because it is easy to replace the broken part of the phone.

17. Implementing a national project that contributes to the governance of the disposal of electronic equipment and computers that are used in the government, banking sector, communications and information technology sector, as well as recycling them in a way that preserves the environment and reduces the risks of electronic waste.

18. Establishing campaigns to collect e-waste in cooperation with the private sector to allocate special facilities to deal with electrical and electronic devices, in order to benefit from them through recycling or reforming them.

19. Banning the import of poorly made mobile devices that do not conform to standard specifications and are harmful to health.

20. Adopting the sorting from the source as an auxiliary and strategic option to conserve natural resources in parallel with the start of treatment operations and not before, as it has been proven that it is not serious, allowing an actual increase in the proportion and quality of recyclable materials (plastic, metal,

cardboard...) and conversion (compost) and increase financial returns. The choice of a system based on separating waste at home or at collection points in separate containers for dry and wet materials only is the most realistic and effective.

21. Securing a single health landfill at the national level and according to international standards to get rid of all exhausts resulting from thermal treatments of domestic waste and from treating medical, industrial and other waste.

22. Imposing strict laws to prevent countries and giant companies from using toxic chemicals in some of their products.

Questionnaire on E-Waste

This survey has been performed randomly on 100 persons in Egypt about the interaction of various groups with e-waste, in order to understand the societal behavior towards e-waste, and deal with it and the statistics on this survey are as follows:

By gender, 36% of those who filled out the questionnaire were male and 64% were female as indicated in Figure 4a.

By age, 12% of respondents were under 20 years old, 64% were between 20-40 years old, and 24% were older than 40 years old as indicated in Figure 4b.

According to the employment, 67% said they hold jobs and 33% do not hold any jobs as indicated in Figure 4c.

According to the knowledge of the danger of e-waste, 47% of them stated that they know the extent of this danger, 46% do not know the danger of e-waste, and 7% are not interested in knowing the danger of e-waste as shown in Figure 4d.

According to the knowledge of e-waste sources, 53% of them stated that they know the sources of such waste, 39% do not know the sources of such e-waste, and 8% are not interested in knowing the sources of e-waste as shown in Figure 4e.

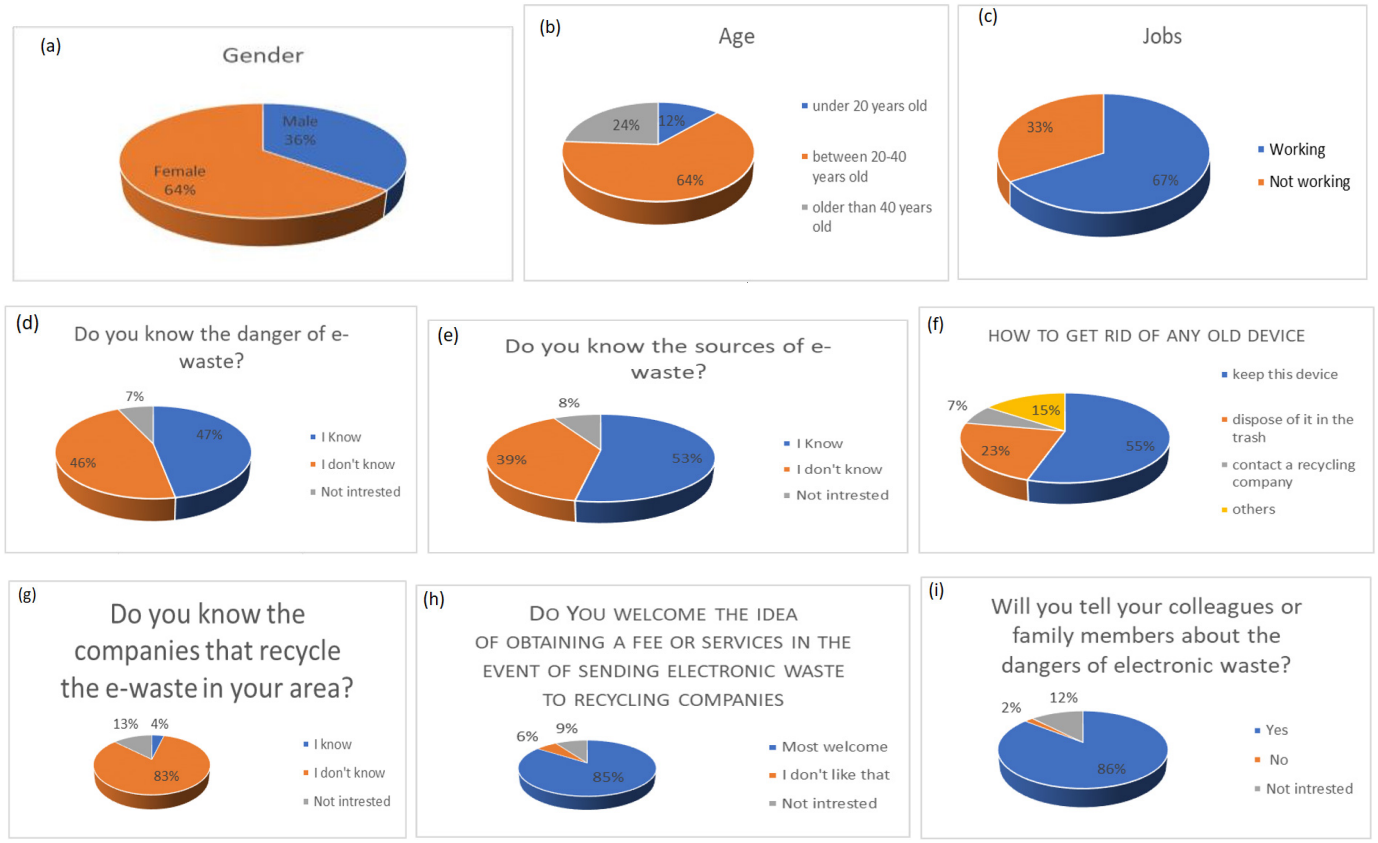


Figure 4: The questionnaire result based on informing others about the danger of e- waste. (a) The questionnaire result based on the gender. (b) The questionnaire result based on the age. (c) The questionnaire results according to the employment. (d) The questionnaire result based on the knowledge of the e-waste danger. (e) The questionnaire result based on the knowledge of the e-waste sources. (f) The questionnaire result based on dealing with old devices. (g) The questionnaire result based on welcoming the idea of obtaining a fee or services in the event of sending electronic waste to recycling companies. (h) The questionnaire result based on the knowledge of e-waste companies. (i) The questionnaire result based on informing others with the danger of e-waste.

According to how to get rid of any old device, 55% of them said that they keep this device, 23% dispose of it in the trash, 7% contact the electronic waste recycling company, and 15% others as shown in Figure 4f.

According to the knowledge of companies that recycle e-waste in the area in which the respondents live, 4% of them said that they know these companies, 83% do not know the recycling companies in their area, and 13% are not interested in knowing these companies as shown in Figure 4g.

According to welcoming the idea of obtaining a fee or services in the event of sending electronic waste to recycling companies, 85% of them said that they welcome this idea, 6% do not welcome this idea, and 9% are not interested in it as shown in Figure 4h.

According to whether those who filled out the questionnaire would educate their colleagues or family members and tell them about the danger of e-waste, 86% of them said that they would educate their colleagues and family members and tell them about the danger of e-waste, 2% would not educate their colleagues or their household or inform them about the danger of e-waste, and 12% are not interested in that as indicated in Figure 4i.

Conclusion and Recommendations

It is clear from this survey and questionnaire that, a large percentage of those who filled it out were aware of the danger of e-waste by 47% and that 46% of them were not aware of its danger and that 53% of them have admitted that they know the sources of such waste and that 39% do not know the sources of such e-waste, which requires the work of programs Awareness- raising at the state level to clarify the extent of the danger of such waste, present its sources and present the effects of unsafe disposal of such electronic waste, in addition to the importance of electronic waste recycling. In addition, there is a desire to accelerate the scientific and practical solutions development for how to dispose of electronic waste in Egypt.

As for 55% of those who filled out the questionnaire retaining electrical and electronic devices, 23% of them dispose of these devices by disposing of them in the trash, and 7% of them contact the electronic waste recycling company and 15% of others, which requires making videos Awareness about the safe disposal of these wastes due to poor handling, which causes many diseases that harm human health.

As for knowledge of companies that recycle electronic waste in the area in which the respondents reside, 4% of them said that they know these companies, 83% do not know the recycling companies in their area, and 13% are not interested in knowing these companies, which requires making applications on The mobile phone shows the nearest companies and places specialized in the recycling of electronic waste, which contribute to the safe disposal of such waste instead of throwing it in the trash.

As for welcoming the idea of obtaining a fee or services in the event of sending electronic waste to recycling companies, 85% of them said that they welcome that idea, 6% do not welcome that idea, and 9% are not interested in it. This item can be implemented with the help of mobile companies, which It can give those who buy a new phone many points by replacing the old phone with a new one.

As for their welcome to educate their colleagues or family members and tell them about the danger of e-waste, 86% of them said that they will educate their colleagues and family members and tell them about the danger of e-waste, and that 2% will not educate their colleagues or the people of their homes or inform them of the danger of e-waste, and 12% are not interested in that. The result is very promising and shows people's interest in this serious issue.

In this paper, the size of the electronics industry in Egypt has been introduced plus introducing the factories that work in the e-waste recycling in Egypt. In addition, a proposed e-waste management has been presented for effectively manage the e-waste in Egypt.

A clear strategy along with policy should be created. This policy should be established based on three pillars anticipation of pollution, comply, with continual and legislations enhancement.

Acknowledgment

The authors are indebted to the electronic waste laboratory at the Electronics Research Institute for providing sufficient facilities and resources for conducting this paper. In addition, we would like to thank the Academy of Scientific Research and Technology (ASRT) for funding the "Electronics Industry in Egypt and Electronic Waste Recycling Industry-Circular Economy" project, which helped us fulfilling this paper.

References

1. Khan AA, Sajib AA, Shetu F, Bari S, Zishan MSR, et al. (2021) Smart waste management system for Bangladesh. 2nd International Conference on Robotics, Electrical and Signal Processing Techniques (ICREST), pp. 659-663.
2. Qi J, Sun B, Feng M, Sun J (2020) Research on evolutionary game model of waste electronic product recycling behavior from the perspective of competition and cooperation. 5th International Conference on Control, Robotics and Cybernetics (CRC), pp. 76- 80.
3. Misra NR, Kumar S, Jain A (2021) A review on e-waste: fostering the need for green electronics. International Conference on Computing, Communication, and Intelligent Systems (ICCCIS), pp. 1032-1036.
4. Wang B, Li H (2020) Optimization of electronic waste recycling network designing. 5th International Conference on Electromechanical Control Technology and Transportation (ICECTT), pp. 368-371.
5. Das A, Debnath B, Modak N, Das A, De D (2020) E-waste inventorisation for sustainable smart cities in India: A cloud-based framework. IEEE International Women in Engineering (WIE) Conference on Electrical and Computer Engineering (WIECON-ECE), pp. 332-335.
6. Abdel AMAH, Mubarak MI, Ali MI, Abdo SM (2016) Avoiding risks of electronic wastes on human's health through establishment of an e-waste management system in Egypt. Egyptian Journal of Occupational Medicine 40(2): 237-252.
7. http://dar.aucegypt.edu/bitstream/handle/10526/5723/Thesis-20Sustainability%20of%20ewaste%20management_%20Egypt%20Case%20study.pdf?sequence=1
8. http://www.mcit.gov.eg/Ar/Media_Center/Press_Room/Press_Releases/14901
9. https://www.sustainable-recycling.org/recycling-initiatives/egypt/