

New Era of Waste Management: Transforming E-waste into Innovative Creations through Upcycling

Introduction

Globalisation, technical advancements, the development of the Internet, and closer access to smart devices have contributed to the growth of the electrical and electronics industries. The wide availability and the use of electronic items have led to a rapid increment in global electronic waste (e-waste) volumes, because markets have not paid adequate attention to electronic device post-consumption behaviour, proper disposal and management. There are significant environmental problems connected with e-waste at both the local and global levels that demand more attention from governments, businesses, institutions and society. Everyone is familiar with waste recycling but there is an emerging trend, called upcycling. Upcycling electronics is an effective and viable procedure for converting end-of-life devices into new ones. The procedure refers to the modification of old waste materials, to recreate and give them a new life or purpose without having to spend a lot of money on new resources. This approach is used not only to improve living quality; but also to provide the developed items with a sense of higher environmental worth. It will also improve the artistic value of the creation. This article aims to provide a solution to problems that arise because of e-waste.

What is E-waste?

E-waste, electronic garbage, e-scrap, and end-of-life electronics are all words for worn electronics that have reached the end of their useful life and have been discarded, donated, or delivered to a recycler. According to The Global E-Waste Monitor 2014 report by the United Nations University e-waste is “a term used to cover all items of electrical and electronic equipment (EEE) and its parts that its owner has discarded as waste without the intent of re-use”. It is also referred to as WEEE (Waste Electrical and Electronic Equipment), electronic waste, or e-scrap in different regions.



Image 01: Electrical equipment piled up without proper disposal

Source: The Growing Environmental Risks of E-Waste, (2021)

How Does it Become a Matter of Major Concern?

Most consumer electronics are meant to have a short lifespan, and when they are discarded, they can cause significant challenges. According to a UNEP press release in 2019, the globe generates around 50 million tons of electronic and electrical waste (e-waste) every year, which is equivalent to the weight of all commercial aeroplanes ever made and unfortunately, only 20% of this waste is formally recycled. The growing volume of electronic waste, including discarded products with a battery or plug, such as mobile phones, laptops, televisions, refrigerators and electrical toys, poses a major threat to the environment and human health.

Improper e-waste disposal in landfills or other non-dumping sites is a substantial public health risk, with the potential to contaminate ecosystems for future generations. Toxic chemicals are generated when electronics are incorrectly disposed of and end up in landfills, affecting the earth's air, soil, water, and, ultimately, human health. E-waste is hazardous because the component used to build electronics contains chemicals and substances that are harmful to human health and the environment, including toxic metals, flame-retardants, and persistent organic pollutants (Smith, 2015). E-waste contains highly toxic chemicals like lead, cadmium, mercury, beryllium, BFR, lithium, polyvinyl chloride phosphorous compounds, chlorofluorocarbons (CFCs), and hydro-chlorofluorocarbons (HCFCs).

Irregular dispersal, shattering or melting of electronic waste releases chemicals such as dioxins or dust particles into the air, polluting the atmosphere and damaging respiratory health. With the breakdown of electrical waste, it releases both heavy metals and flammable substances that can leak directly into the soil from the e-waste, contaminating groundwater or polluting crops, plants and trees that are growing from the soil. When these heavy metals reach groundwater they eventually find their way into various water channels, causing acidification and toxification in the water, which is dangerous for animals, plants, and communities that rely on these waters. Improper electrical waste disposal is extremely hazardous to the global ecosystem since it contributes to climate change as well.

Prolonged exposure to these chemicals can lead to many serious health problems later on. For instance, Lead is used in various EEE, such as lead-acid batteries, printed wiring boards (PWB), and cathode ray tube (CRT) screens for televisions and older computers. Lead exposure, especially in young people, can lead to problems with the nervous, blood and reproductive systems. Mercury in fluorescent lamps, LCD monitors, CFLs / tube bulbs and thermometers can damage the human brain and liver. In addition, cadmium used in older CRT monitors, rechargeable batteries and switchers can primarily affect the kidneys and lungs and can cause prostate cancer. Combustion of polyvinyl chloride (PVC) used in pipes, electronics and home appliances releases hydrogen chloride gas, which is toxic and can cause respiratory illness in humans. Exposure to arsenic in EEE can lead to lung cancer, skin diseases and nervous system disorders.

E-Waste: Global Scenarios and Sri Lankan Context

According to the Global E-waste Monitor 2020, Asia generated the highest quantity of e-waste in 2019 at 24.9 Mt, followed by the Americas (13.1 Mt) and Europe (12 Mt), while Africa and Oceania generated 2.9 Mt and 0.7 Mt, respectively. Europe ranked first worldwide in terms of e-waste generation per capita, with 16.2 kg per capita. Oceania was second (16.1 kg per capita), followed by the Americas (13.3 kg per capita), while Asia and Africa generated just 5.6 and 2.5 kg per capita, respectively.

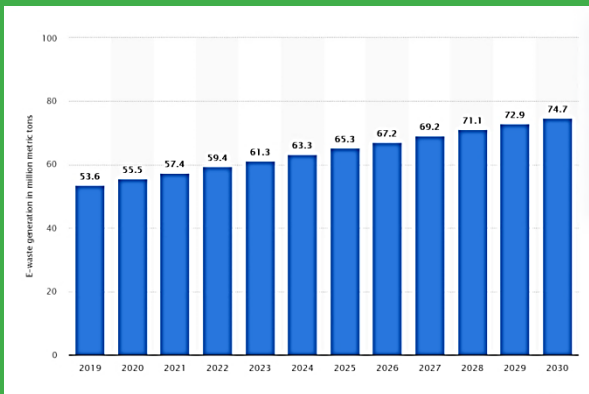


Figure 01: Projected electronic waste generation worldwide from 2019 to 2030 (In million metric tons) (Source: Tiseo, 2021)

Moreover, the Global E-waste Monitor 2020 portrays that in 2019, 53.6 million metric tons (Mt) of e-waste (excluding PV panels) were generated. This trend is anticipated to continue, with forecasts indicating that yearly e-waste generation would have climbed by almost 30% worldwide by 2030. In 2030, the amount of e-waste generated is expected to exceed 74 Mt, warns the United Nations. As a result, the worldwide volume of e-waste is growing at an alarming rate of nearly 2 Mt every year.

E-waste problem has now become a major crisis in Sri Lanka as well. Lack of enough institutional processes in place to collect e-waste, inadequate community understanding about health risks and environmental repercussions, lack of adequate training or knowledge of e-equipment handling, lack of data and control over informal sectors involved in garbage collecting and recycling have exacerbated the E-waste problem in Sri Lanka. The following figure shows the electronic waste forecast for 2020 as compared to the electronic waste generated during the period 2010 to 2015.

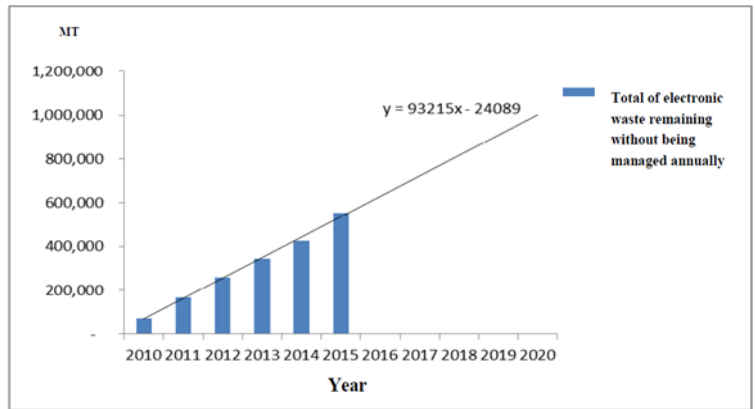


Figure 02: Electronic waste forecast for 2020 compared to electronic waste generated from 2010-2015 (Source: Wijesinghe, 2017)

The diagram above depicts the potential for approximately 1,000,000 metric tons of e-waste to be generated and added to the environment by the year 2020. Therefore, the electronic waste management process currently in place in Sri Lanka is not fully adequate and it exacerbates the problem of e-waste.

Way Forward for a Sustainable Solution

A recent UN report titled ‘A New Circular Vision for Electronics’ highlights that the world produces as much as 50 million tons of electronic and electrical e-waste a year. “However, only 20% of this is formally recycled, the remaining 80% either ending up in landfills or being informally recycled” said Vishwanath Mallabadi, an eco-artist in India. Therefore, finding an ethical recycler is difficult, and promising to eliminate e-waste from the planet has proven difficult. As a result, upcycling e-waste could be used as an appealing option in the current global contest. This technique converts old commodities into reusable items or materials. End-of-life items can be reused to create new products with imagination and innovation. Instead of being sold downstream to material recovery processors, components from upcycling will be utilized to generate items like fascinating artwork toys, vintage collectables, art pieces, and jewelry. This is a safe and environmentally friendly alternative to catastrophic e-waste disposal methods. It is also an efficient and viable technique that converts end-of-life products into new products without wasting energy in manufacturing operation like recycling. This regeneration could include some value addition and prototyping to produce new products, or it could just be finding a new market for components of the old product.

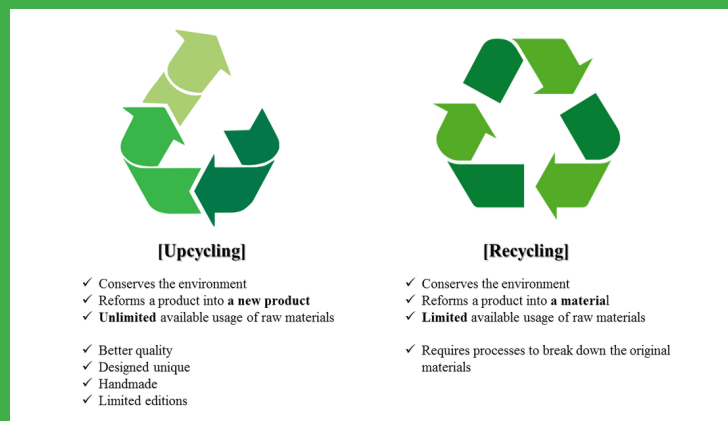


Image 02: Differences between Upcycling and Recycling
Source: Portland State University, 2016

In the context of electronics, recycling could involve renovating the equipment for resale or breaking down the gadget into its constituent components and recovering the valuable metals used in the original structure, such as cadmium, gold, and silver. Upcycling, on the other hand, does not necessitate degradation. It is a new idea: exploring alternative uses for the entire thing or its constituent parts. Both procedures help decrease the number of landfills around the world. Apart from that more significantly, encouraging future generations to repurpose outdated technology is a constructive solution to help them adjust to a greener lifestyle.

In the last three years, many developed countries in the world have been moving towards the concept of upcycling. One good example of large-scale upscaling initiative can be found in South Korea which is at the forefront of technology. Samsung, a South Korean electronics company, has introduced a new programme that encourages consumers to upcycle items that they no longer use, giving obsolete gadgets a new lease on life. They have explained this on ‘the national news website’ under the topic ‘Why Upcycling Tech Is The Future: Your Electronic Devices Can Live Long Past Their Shelf Life’ on Tuesday 14

September 2021. The program, named ‘The Galaxy Upcycling at Home’ initiative is now being tested in three countries: the United States, the United Kingdom, and Korea. Its goal is to use a simple software update to repurpose outdated Galaxy smartphones as the Internet of Things (IoT) devices.

In addition, Forbes Magazine which is known as a powerful means of communicating new ideas or emerging concepts to the world published an article on ‘Make 2021 The Year You Upcycle Your Consumer Electronics Devices’ on January 24, 2021. President, and Co-Founder of ‘UBREAKIFIX’ Company Justin Weatherill, was expressing his views on it and stated that e-waste is the fastest growing waste stream, with high-tech turnover a major factor in the USA and also in the world. Therefore, his working network has focused on the upcycling approach. Wetherill has said that “Cell phones and tablets are the devices we see being upcycled the most (...) as their functionality tends to outlast the typical upgrade cycle, and with proper care and maintenance, these can have great ‘second lives.’” According to Wetherill, the company has seen much more upcycling since the onset of the pandemic because families are bringing in tech they need for work or school, or those they had previously forgotten about, like old game consoles and hover-boards.

When it comes to social media, Daniel Davis who is an electronics wiz, runs the popular Tinkernut YouTube channel for promoting upcycling approach has written a book to present the case for upcycling namely ‘Upcycled Technology’. In the book, he has written “Upcycling is more than just slapping a new coat of paint on a nightstand. To let time and lack of interest steal these hidden treasures from us is like leaving a music box’s melody to be buried and forever lost in a landfill.

As in life, there can be a tremendous benefit in taking a second look at what’s considered worthless junk and embracing it instead of discarding it”.

Moreover, there are some artists using upcycling approach to their creations. Vishwanath Mallabadi in India is one of them. He is an eco-artist who creates beautiful eco art from unusual materials. During his leisure time, he may be seen either separating and inventorying the e-waste he has gathered from various scrap dealers or working to give the e-waste a new lease of life. Vishwanath also presented his imaginative collection on the utilization of electronic waste at the United Nations’ two-day International Data Science Technology Conference for Sustainable Development Goals (SDGs). At the first-ever conference of its kind, he addressed how discarded old phones or telephone spiral wires are not useless to an eco-artist. He told the Hindu (An Indian Newspaper) that he believed Upcycling is the only way to deal with environmental sustainability and to arrest the problem of reducing landfills. “Being a designer and one who cares for the environment, I am concerned about the future generation, and the work I do, I hope, will help in the betterment of the generation. The economics behind my initiative is, if each person stops discarding end of life products, upcycling or re-using them will make a major difference in healthy living,” he has stated. Although other countries in the world are involved in this process, Sri Lanka is still not using the upcycling approach to manage e-waste. Therefore, the time has come for us to understand the challenges around us and take actions at the individual level to make a difference as a nation by building a bridge between Grey and Green.



Image 03: Cassette lamps



Image 06: A coffee table



Image 04: Floppy disk plant holder



Image 05: Candles with old bulbs

Implementation

Implementation is a monumental cause in any proposal. Although upcycling e-waste is a complicated long-term task, a properly planned procedure can lead to good outcomes. Comparatively, the e-waste management in Sri Lanka is at a weak level mainly due to inadequate awareness. Therefore, capacity building and raising awareness is a mandatory requirement. Conducting awareness, training programs among the public on upcycling strategies can address this issue. Moreover, involvement of government authorities, forming national platforms and coordination committees can enhance the effectiveness of the project.

E-waste collection and storage is another important step. In Sri Lanka, collection of e-waste is largely based on informal sector activities like dismantling and most of the e-waste remains in households and institutions without being collected. They usually end up in land fillings, open ground or burning which cause huge environmental damage. At this point the government has a responsibility to get involved and take necessary actions such as implementing national policy on disposal of e-waste, forming a legal framework on collecting e-waste and maintaining a standardized national database for the e-waste sector that can regulate the e-waste collection mechanisms. Under these regulations and frameworks, we can operate an island wide e-waste collection network to collect e-waste for up-cycling.

Upcycling e-waste is a concept, which can initiate with simple creative and innovative ideas. But for better sustainable and profitable outcomes, advanced technological competencies are essential. Hence, on top of the involvement of local educational institutions and experts, avail collaboration of foreign technologies can overcome technological barriers.

Sri Lanka can use environmental diplomacy to attract foreign technological experts and investors. At present, environmental diplomacy plays a crucial role in international relations by addressing issues related to environmental security at a multilateral level. It empowers cooperative negotiations, technological collaboration, economic assistance and research among states to combat global environmental issues. For instance, the United Nations plays a noteworthy role to tackle the transnational and substantial global problem of e-waste. Global E-waste Statistics Partnership (GESp),

International Telecommunication Union (ITU), International Solid Waste Association (ISWA), UN Environment Program (UNEP), Global Partnership on Waste Management (GPWM), United Nations Institute for Training and Research (UNITAR) are some UN related entities that provide expertise, technological and advisory assistance concerning e-waste crisis at regional and global level.

Furthermore, monitoring the whole manufacturing process from design stage to the final production stage can maintain relevant quality standards of the final product. Regulations for licenses or permits can further regulate the manufacturing process. Under these conditions upcycled products with an added value have potential to earn higher market value while combating the crisis of e-waste.

Impact of Upcycling E-waste

Upcycling generally refers to the conversion of waste materials to something useful or valuable. In fact, this concept can address many environmental and health issues by slowing the release of toxic chemicals to the environment and reducing its impact on the environment. Therefore, upcycling is indeed a sustainable solution for the growing e-waste management problem.

Other than environmental and health benefits, upcycling can earn many economic benefits. Newly modified e-waste products can meet the needs of various sectors of the country and as a source of entrepreneurship, upcycling will become a solution for unemployment. Besides, quality upcycled products

will acquire significant prices in the international market and attract investment opportunities. Moreover, when exchanging knowledge between countries, it can strengthen the cooperation among countries and lead to new inventions for the betterment of the entire world.

Furthermore, e-waste management closely relates to the 2030 Agenda for Sustainable Development. The global crisis of e-waste poses significant challenges to the achievement of several Sustainable Development Goals such as SDG 3 on good health and well-being, SDG 6 on clean water and sanitation, SDG 8 on decent work and economic growth and SDG 14 on life below water. Therefore, preparing an appropriate background for advancing e-waste management through upcycling strategies is a must because “Failing to Prepare Is Preparing to Fail” as said by Benjamin Franklin.

Conclusion

Upcycling is the process of transforming discarded materials into something useful or valuable. Reducing the usage of new raw materials can lower energy consumption, pollution, and greenhouse gas emissions. Developing more sustainable solutions is an inevitable priority, given that the presence of most electrical equipment in every home is unavoidable. Upcycling provides homeowners with tax benefits and a less expensive, more fun option for furnishing their homes. In the future recycling will not be the primary option for e-waste disposal, rather it could be one of the last possibilities for recovering the value of materials. Therefore by Upcycling e-waste, the impact of resource extraction on the environment can be reduced.



Image 10: Upcycling is a key to sustainable goals

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