

TOWARDS GREEN ELECTRONICS

Luka Nesić¹ Danica Nesić² Bratimir Nesić³ Miodrag Smelcerović⁴ Milos Cvetković⁵

Abstract: Electronic devices are composed of numerous materials, many of which include hazardous chemicals such as heavy metals, hexavalent chromium, beryllium, brominated flame retardants, and polyvinyl chloride. The presence of these toxic compounds poses significant risks not only during the production and manufacturing stages but also throughout the entire lifecycle of the products, including their disposal. Recycling electronic devices is not a comprehensive solution to the e-waste crisis, as it can introduce additional challenges related to the hazardous materials involved. The paper highlights the environmental and health impacts of these toxic chemicals at every stage of an electronic product's lifecycle. To address the e-waste crisis, the paper outlines potential solutions and emphasizes the importance of transitioning to environmentally friendly electronics. It also encourages individuals to take proactive steps to promote sustainable practices in the electronics industry.

Key words: green, electronics, recycling, hazardous, chemicals.

1. INTRODUCTION

Obsolete electronic products, if not reused, are often processed to reclaim metals and recycle plastics. However, even advanced recycling technologies can lead to environmental pollution, exposing workers and nearby residents to harmful metal fumes and dioxins from the smelting of certain materials. This highlights the critical role of product design in ensuring safe waste management practices.

The market for consumer electronics is experiencing rapid growth, with significant sales figures reported in 2008, including 1,22 billion mobile phones and 302 million computers [1]. The gaming console sector is particularly notable for its rapid expansion, with 409,9 million units sold that same year [2]. Furthermore, the growth of IT data centers has contributed to the IT sector being responsible for 2% of global CO₂ emissions in 2007 [3] a figure expected to rise significantly in the coming years.

2. THE TOXIC LIFECYCLE OF ELECTRONIC PRODUCTS

Branded products are merely the visible outcomes of a complex global industrial network that prioritizes cost reduction in material resources and labor, often at the expense of social and environmental standards. The lifecycle of electronic devices begins with the extraction of raw materials, which poses significant environmental risks and endangers workers during production and disposal.

Manufacturing has increasingly shifted to regions with cheaper labor, such as Latin America, Southeast Asia, India, China, and parts of Eastern Europe. This trend often correlates with poor environmental practices, leading to contamination from hazardous chemicals used in production.

At the end of their lifecycle, electronic products contribute to a growing e-waste crisis, with an estimated 20 to 50 million tonnes generated annually [4]. While developed countries have advanced waste management facilities, much of the e-waste is illegally exported to Asia and Africa, where rudimentary recycling methods expose workers, including children, to toxic substances.

The informal recycling processes prevalent in these regions exacerbate the dangers associated with hazardous materials in electronics. Studies have shown alarming levels of toxic emissions from burning materials like PVC cables and circuit boards, leading to severe environmental contamination and health risks for local populations [5], [6].

Despite the growing e-waste problem, electronics companies report that only a small fraction of their products are responsibly recycled, with less than 40% of branded PCs and under 9% of branded

¹B. Sc. Student, Faculty of Electronic Engineering, Aleksandra Medvedeva 4, Nis, email: lukanesić18532@gmail.com

²B. Sc. Student, Faculty of Electronic Engineering, Aleksandra Medvedeva 4, Nis, email: nesić.danica@elfak.rs

³Ph. D. Student, Faculty of Occupational Safety, Carojevica 10A, Nis, email: bratimir@gmail.com

⁴Professor, Academy of Vocational Studies Southern Serbia, Leskovac, email: msmelcerovic@yahoo.com

⁵M. Sc. Student, Academy of Vocational Studies Southern Serbia, Leskovac, email: milos.cvetkovic@pww.rs

mobile phones being accounted for [7]. This indicates a significant gap in producer responsibility, as a large percentage of these devices are likely disposed of improperly. The escalating volume of obsolete electronics poses a potential crisis, necessitating that corporations acknowledge and address their responsibilities in managing e-waste effectively [8].

3. E-WASTE – "NOT IN MY BACKYARD"

The UN estimates that some 20 to 50 million tonnes of e-waste are generated worldwide each year, comprising more than 5% of all municipal solid waste. The quantities of e-waste generated are predicted to grow substantially in the future both in industrialised countries and in developing countries, which are expected to triple their output of e-waste by 2010 [9].

The United Nations University's latest estimate of current waste electrical and electronic equipment arising across the EU Member States is between 8,3 and 9,1 million tonnes for early 2000s, while the estimated amount currently collected and treated is allegedly some 25% of that, leaving a "hidden flow" of 75% remaining to an unknown fate. The total amount of e-waste arising in the EU is predicted to grow annually between 2,5% and 2,7%, reaching about 12,3 million tonnes by 2020s [10]. While producers in the EU have been made responsible for dealing with e-waste under new regulations, and e-waste exports fall under shipment regulation banning its export to non-OECD countries, evidence shows that such export is still happening – by either illegal means (trafficking), through regulatory loopholes or under the pretext of reuse and charity donations to developing countries.

The situation in the US is quite different. Despite certain US States implementing their own e-waste equipment initiatives and some of the major companies beginning to take producer responsibility by setting up voluntary take-back and recycling schemes, e-waste remains unregulated at the federal level, exports of e-waste to non-OECD countries are legal and national levels of collection are far too low to make an impact. According to the US Environmental Protection Agency [11], 18% of PCs, laptops and monitors reaching end-of-life in 2007 were collected for recovery, along with 18% of TVs and 10% of mobile phones. But without sound regulations and even a comprehensive data assessment, these figures are likely to be optimistic as the EPA's definition of recovery includes exports of e-waste to developing countries, which is unacceptable. All in all, the hidden flow of e-waste escaping responsible recycling in the US may be as much as 80% or more.

For non-OECD countries such as China and India with large informal recycling sectors, it is simply not possible to even estimate the percentage of the hidden flow of e-waste. In these rapidly industrialising countries the demand for the recovery of valuable raw materials, as well as cheap labour, feeds the import of e-waste from developed countries, which adds to the growing domestic e-waste problem. In India, 99% of domestic and imported e-waste is estimated to end up in the informal recycling sector [12], with a high toll on health, safety and the environment and a rather poor rate of material recovery. Other regions are also under threat of illegal imports of e-waste, such as African countries where donations for refurbishment and reuse are simply a pretext for the dumping of non-repairable devices.

Thanks to uncovering of the hidden flows - Greenpeace investigations revealed e-waste being illegally exported to Pakistan and Ghana for crude recycling and dumping. For example, in February 2009, Greenpeace revealed the results of an in-depth investigation that revealed a broken TV delivered to Hampshire County Council in the UK was tracked being exported illegally to Nigeria [13]. This is just one example of the illicit trade in e-waste that is happening in many parts of the world.

Hidden flows include:

- From the US to Africa/Asia: no laws, legal export
- From the EU to Africa: illegal export or under cover of reuse/donation
- From the EU to Asia: illegal export or under cover of recycling

- From Japan to South-East Asia: export under trade agreements

4. HAZARDOUS CHEMICALS IN ELECTRONIC PRODUCTS

Lead can be found in solders, although decreasingly, in the glass of cathode ray tube (CRT) monitors and as a stabiliser in PVC. Lead is highly toxic and exposure to lead can result in irreversible damage to the nervous system, particularly in children [14], which can lead to intellectual impairment.

Mercury, used in lighting devices for most flat screen displays, can damage the brain and central nervous system, particularly during early development [15].

Cadmium, used in rechargeable computer batteries, contacts and switches and in older CRTs, can accumulate in the body over time and is highly toxic, primarily affecting the kidneys and bones. Cadmium and its compounds are also known human carcinogens [16].

Beryllium, used as a metal alloy in electrical contacts and as beryllium oxide in the semiconductor industry, is a human carcinogen and inhalation of fumes and dusts can cause lung disease [17].

Compounds of hexavalent chromium, used in the production of metal housings, are highly toxic and are human carcinogens [18].

Some BFRs used in circuit boards and plastic casings do not break down easily and can build up in the environment, and some BFRs are also highly bio-accumulative (build up in the body). Longterm exposure to certain polybrominated diphenylethers (PBDEs) has been linked to abnormal brain development in animals, with possible impacts on learning, memory and behaviour. Some BFRs can also interfere with thyroid and oestrogen hormone systems and exposure in the womb has been linked to behavioural problems. Incineration or any kind of burning of plastics containing BFRs can cause the release of persistent dioxins and furans [19] - [21].

PVC is a chlorinated plastic used in some electronics products, including for insulation on wires and cables. Although not directly toxic, PVC is a major source of pollution and chemical hazard at all stages of its life cycle. In its softened form (as found in cables), PVC requires the use of additives such as hazardous phthalates, including di(2-ethylhexyl) phthalate (DEHP) and di-n-butyl phthalate (DBP), which are known as reproductive toxins. Incineration or any kind of burning of PVC can cause the release of persistent and toxic chlorinated dioxins and furans [22] - [24].

5. CLIMATE CHANGE AND THE IT INDUSTRY

The climate change impact of the IT industry on emissions is being recognised more widely and starting to be addressed. What is less well known is that IT has the potential to be a big part of the solution to climate change. The industry's carbon footprint is currently growing, and much green IT potential remains unrealised, or lacks detailed studies showing how or where overall emissions can be reduced.

Greenpeace is pressuring the biggest names in the IT industry to move quickly to produce climate solutions and reduce their own emissions. The IT sector creates 2% of global greenhouse gas emissions, but IT services and products have the potential to cut the world's emissions when applied in industry, buildings, transport and power sectors.

The IT industry can and should be at the vanguard of climate solutions. We have all seen how tech companies compete with each other to provide the newest, fastest, and shiniest gizmos to power our lives. It is only natural that they now apply that knowhow and compete with each other to see who can provide the best (and profit the most from) IT climate solutions.

Many IT companies, including HP, Nokia, Microsoft, Sun, Cisco and Ericsson, Google, Dell, IBM and Lenovo have already said that they are able to provide IT solutions that will reduce projected global greenhouse gas emissions by 15% by 2020. That's a big portion of the 40% reductions needed in industrialised countries by 2020.

Because Greenpeace wants to take IT's potential to drive transformational change and make it reality, they have launched Cool IT Challenge, an effort to expose the IT industry's inadequate leadership in tackling climate change and challenge them to do better. Greenpeace began its Cool IT Challenge in February 2009 with a letter to the CEOs of the major IT companies asking them to take specific action prioritising climate change in 2009. They then scored the companies according to their responses to specific requests in that letter, which urged them to show leadership by:

- Providing IT solutions and accurately measuring the impacts these solutions provide for the rest of the economy. These solutions come in vital areas in such as grid transmission, transport, and building efficiency;
- Lobbying for a strong international and national climate legislation. Strong legislation will create a stimulus for an increase in demand for IT driven climate solutions by the rest of the economy;
- Reducing their own emissions and increasing their use of renewable energy.

The Cool IT Challenge is updated periodically to show which of the world's biggest tech companies are leading the way on tackling the most urgent climate priorities. Decisive action is needed now from global IT giants to help lead the way in the clean tech revolution that's needed to tackle climate change [25].

6. CONCLUSION

International environmental organizations, particularly Greenpeace, advocate for major electronics manufacturers to adopt several key principles. These include embracing "Individual Producer Responsibility," which entails financial accountability for products at the end of their life cycle. Additionally, there is a strong push for the elimination of toxic substances in product design, promoting the use of safer alternatives. The overarching solution to the e-waste crisis is seen as rooted in improved product design.

What steps you can take towards helping to green the electronics sector? Browse our campaign webpage on www.greenpeace.org/international/campaigns/toxics/electronics and engage with us in greening the electronic sector. Check regularly Greenpeace Guide to Greener Electronics. When buying electronic products, use the Guide to identify the makers of greener models available for purchase and to choose only manufacturers consistent in their efforts to green their act and who offer free take-back globally. Take action to turn IT companies into climate leaders at www.greenpeace.org/coolit. If you're disappointed with your favourite brand's environmental performance, do let them know! When your device becomes obsolete return it to the manufacturers for them to ensure a sound waste management – if you face refusal, make a complaint and let us know what kind of response you receive! Talk to your friends and relatives about the dangers of toxic chemicals in electronic devices and the growing problem of e-waste – the more people who share your concerns, the more people will demand that producers live up to their responsibilities. Get involved! You can join global community of online Greenpeace activists or use your own website or blog to spread the word, you can volunteer or work for Greenpeace, make your life a little greener by following our tips for green living or you can share with Greenpeace your own ideas. Details of how to do all of these things can be found on our website at www.greenpeace.org/international/getinvolved.

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