

FALL 2019

UAB GLOBAL HEALTH CASE COMPETITION



Health & policy implications of trash & e-waste mismanagement in Agbogbloshie, Ghana

Connecting students from diverse fields to address a global health challenge



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All characters and plots described within the case are considered fictional and bear no direct reflection of existing organizations or individuals. The case topic, however, is a true representation of circumstances in Accra and Agbogbloshie, Ghana. The case scenario is complex and does not necessarily have an ideal solution, thus encouraging a discerning balance of creativity and knowledge. Provided are informative facts and figures within the case and appendices to help teams create a proposal. The data provided are derived from independent sources, may have been adapted for use in this case, and are clearly cited allowing teams to verify or contest them within their recommendations, if necessary. Teams are responsible for justifying the accuracy and validity of all data and calculations that are used in their presentations, as well as defending their assertions during judging.

Cover photo sources are as followed: *Top left, Ghana e-Waste Country Assessement, SBC e-Waste Africa Project; Top right, Ghana e-Waste Country Assessement, SBC e-Waste Africa Project; Bottom left, Adam Minter/smithsonianmag.com; Bottom right, Jon Spauill/SciDev.Net*

Introduction

Opening Scenario

Efie had a lot on her mind as she boarded the bus that would take her across Accra to her office at the Ghanaian Health Advocacy Network of Accra (confusingly called GHANA for short). For one, Efie needed to propose a new advocacy focus project to her boss. She'd been brought on with the organization three years before to work on a maternal health initiative in the city's slums, but now that it had wrapped up, she needed to show that she could be a leader on something new. GHANA had just received a request for proposals for a unique grant from the United Nations Environment Programme (UNEP) that would require a certain percentage of the funds to focus on a particular health intervention with the remaining portion supporting advocacy efforts. Efie still wasn't sure what to make of this grant opportunity or what particular issue she should focus on if GHANA were to submit a proposal.

Also on Efie's mind was a text from her friend Doreen. Doreen lived in the Old Fadama slum on the other side of the city and had been a key community advocate on Efie's last project. They'd worked together for so long they couldn't help but become friends.

Just that morning Doreen had texted to say her 8 year old son Afram had been badly burned while playing with friends. The boy had gotten too close to a smoldering fire leftover from e-waste recyclers who were burning the insulation off cables to retrieve the metal inside. Doreen's house was next to the Agbogbloshie waste site where kids often played among the broken refrigerators, car tires, and electronics. Some kids would skip school to help the recyclers, and make a little money to take home. Efie mentally ticked off what she needed to get done in the office so that she could visit Doreen and make sure Afram was getting medical treatment for his burns.

As the bus continued to roll through the city, Efie's thoughts of young Afram and the situation at Agbogbloshie started mixing with her assignment at work. When she disembarked the bus, Efie had more energy than 20 minutes earlier. She had the perfect idea for their next project.



1: Flag of Ghana

Demographics: Ghana & Accra

Ghana gained independence from Britain in 1957, the first country in sub-Saharan Africa to do so. After decades of political instability, a new constitution reformed the government into a presidential republic in 1992. Since then, the presidency has consistently seen a peaceful transition between administrations (Central Intelligence Agency, 2019).

An estimated 28.1 million people live in Ghana, with several ethnic groups making up the population; no one ethnic group comprises more than half of the population. Multiple languages are spoken in Ghana, but English is the official language and serves as a lingua franca for Ghanaians. About 71% of the population identifies as Christian, with 18% identifying as Muslim, 5% following traditional beliefs, and 5% not identifying with any religion. More than half (57%) of the population is under the age of 25, with the median age being 21.2 years. Of those over the age of 15, 76.6% can read and write. Ghana has been experiencing an influx of migration from rural areas to urban centers – a 3.34% annual rate of change, with urban areas already containing 56.1% of the population. The Ghanaian economy is growing quickly, with a growth rate of 8.4% in 2017, and the GDP per capita amounting to \$4,700. The agriculture sector comprises 20% of Ghana's economy. Gold, oil, and cocoa exports, along with remittances, account for a large portion of foreign exchange. 24.2% of the population lives below the poverty line. (Central Intelligence Agency, 2019).

Ghanaian life expectancy at birth is 63.4 years. Infectious diseases are common in Ghana. In 2016, about 15.5 million people required intervention for a neglected tropical disease. Regarding noncommunicable diseases in the same year the probability of dying between the ages of 30 and 70 from cardiovascular disease, diabetes or chronic respiratory disease was 20.8%. Environmental pollution is another risk to Ghanaian health, with the age-standardized mortality rate attributed to household and ambient air pollution up to 203.8 per 100,000 population in 2016. The annual mean concentration of fine particulate matter in urban areas is about 31.1 $\mu\text{g}/\text{m}^3$ – the World Health Organization (WHO) guideline suggests no more than 10 $\mu\text{g}/\text{m}^3$. Additionally, mortality rate attributed to exposure to unsafe WASH services was 18.8 per 100,000 population. In 2016, only 27% of the population was using safely managed drinking water services (WHO, 2018).

Accra is the capital of Ghana. The 2010 census puts the population of the Accra Metropolitan District at 1.66 million people. Current estimates from the UN suggest a current population of 2.48 million. The region as a whole is a hotspot for emigration, with about 53% of people in the Greater Accra Region having migrated to the district either from other parts of Ghana or other parts of Africa. Consistent with the rest of the country, over half (56%) of the population in Accra is under the age of 24 (Ghana Statistical Service, 2013; World Population Review, 2019).

Global Trash & E-Waste



2: Electronic waste items in Agbogbloshie, Source: Martin Holzknicht, Arnika

Introduction to trash & e-waste

Globally there has been poor recognition of the issue of trash disposal and its effect on health, safety, the environment, and more. Trash production is often proportionate to a country's degree of urbanization and industrialization, with the U.S., China, Brazil, Japan, and Germany ranking as top trash producers. In 2016, the world's cities alone created 2.01 billion tons of solid waste. Still, more than half of the world does not have access to regular trash collection (Simmons, 2016; The World Bank, 2019).

E-waste is defined as electrical and electronic equipment waste, including, but not limited to: computers, mobile telephones, keyboards, printers, cables, cords, microwaves, etc. In just the last decade, a combination of increasing electronics ownership along with shortened lifespan of electronics has led to a dramatic increase in e-waste. Because of a lack of e-waste regulations and improper tracking of e-waste generation in many countries, the estimated global e-waste production ranges from 20 million tons a year to 40 million tons a year. (Grant et al., 2013; Robinson, 2009; Terazono et al., 2006; Zhang et al., 2012)

As a result of the high cost of proper e-waste disposal at special recycling facilities, nearly 80% of the e-waste generated in high-income countries is exported to China and certain countries in Africa. The e-waste trade process is fueled by the strong demand for raw materials as well as low labor costs in developing countries (Lundgren, 2012; Zhang et al., 2012). Some countries receiving e-waste imports have recycling centers for e-waste; however, they are often overwhelmed or inaccessible. In a review article investigating India's recycling centers and their response to e-waste, many were unable to cater to large e-waste amounts from different regions. Additionally, many of the

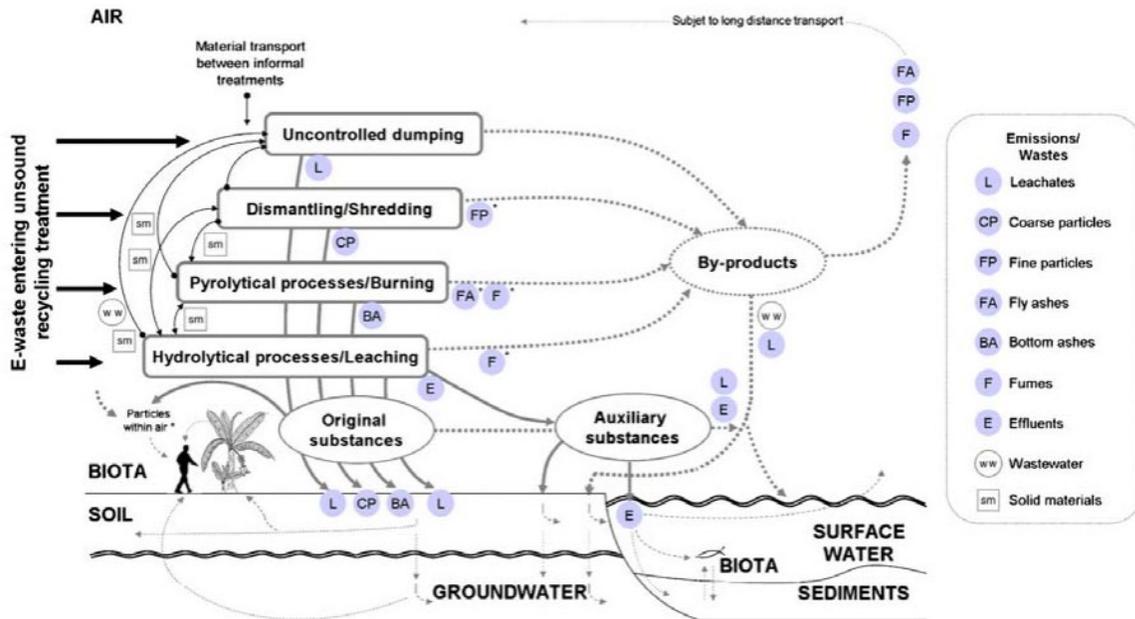
people in the recycling centers, commonly from populations that are urban, poor, and barely literate, face hazardous toxin exposure (Pinto, 2008). The Lancet (2013) claims these workers often neither use personal protective equipment nor are aware of the deleterious effects of toxin exposure.

Health impacts

Environmental health impacts.

The mismanagement of trash and illegal dumping practices have serious implications on the environmental health of surrounding areas. It poses adverse short and long-term threats on polluting natural resources like land, air, and water. Landfills are the most popularly used waste disposal method, and populations residing in close proximity to landfill sites are harmed by the accumulation of pollutants, injuries and lacerations, infection and disease transfer. Biogases released from these landfill sites contaminate the air, causing allergies, irritation, and even cancer and birth problems in addition to being responsible for ground and surface water contamination (Maheshwari, Gupta, & Das, 2015). The majority of environmental pollution from e-waste results from dismantling, material recovery, and final disposal processes. These processes are known to discharge harmful chemical directly into soil. Ash and partially burned materials build up. The burning of car tires and other long-lasting fuels for pyrolytic processing in itself contributes to chemical exposures, not to mention the material undergoing the processing (Amoyaw-Osei, Agyekum, Pwamang, Mueller, Fasko, & Schlupe, 2011).

Figure 1 - Principle WEEE Recycling Activities (Amoyaw-Osei et al., 2011)



The toxic compounds in factory waste and household garbage dissolve in natural water reservoirs used by humans for drinking, washing, cleaning, and bathing. E-waste contains harmful elements like lead, cadmium, chromium, etc. (WHO, 2017), which can accumulate in the soil, water, and food. The harmful chemicals from e-waste leach into the water and soil, and toxins produced as a result of the burning of e-waste become a part of the air that people breathe. E-waste alone is generally comprised of more than 60% heavy metal ions and about 2.7% other pollutants, making it highly toxic and hazardous (Wildmer, Krapf, Khetriwal, Schnellmann, & Boni, 2005). Multiple research studies have concluded exposure to e-waste can change thyroid function, change cellular expression and function, and decrease lung function (Grant et al., 2013). Poisoning of food by hazardous chemicals, air toxicity, prevalence of disease carriers, and infectious outbreaks are just some of the implications of the environmental hazards posed by trash mismanagement in affected areas like the Agbogbloshie slum in Accra, Ghana.

Human health impacts.

When developing nations process e-waste, some of it is dismantled, shredded, or burned in informal “backyards”. Gold and other valuable metals are extracted by open-air burning of discarded electronics, cables etc.—increasing public exposure to organic compounds such as dioxin, and toxic metals such as lead and cadmium (Kumar & Arun, 2014). In one of the largest e-waste processing sites in Guiyu, China, fine particulate matter produced from open-air burning has been linked with respiratory, digestive, cardiovascular, integumentary, and neurological complications after inhalation or

ingestion (Guo et al., 2010). Research has also linked particulate matter with increased expression of Interleukin 8 (IL-8) and Reactive Oxygen Species (ROS)- biological markers of inflammation, metabolic stress, and DNA damage (Yang, Jin, Xu, & Lu, 2011). Particulate matter from burning can also be dispersed by winds and travel before being deposited and entering the soil and crops in other locations—a major human exposure route (Robinson, 2009). In a study by Zheng et al. (2013) rice samples collected from locations around e-waste processing sites showed concentrations of copper, nickel, lead, and cadmium that were nearly twice the maximum permissible concentrations.

Adverse effects from particulate matter and heavy metals are not the only health risks posed by e-waste and trash. Improper disposal or storage allows standing water to accumulate and provide a breeding ground for *Aedes* mosquitoes—vectors of yellow fever, zika virus, dengue fever, and malaria (Thomson, 1995). Additionally, sandflies and carriers of leishmaniasis and bartonellosis can breed in standing water (WHO & UNEP, 1991). Even when sterile, uncollected trash and e-waste deposits pose fire and flood hazards as they can accumulate in landfills and drainage systems. Effluent, or waste disposed of into a water source, can leach into ground and open water sources—again contaminating the soil, crops, and marine life. Exposure to biological or chemical agents from dump sites, landfills, and incinerators has been linked with physiological effects such as low birthweight, thyroid malfunction, and genotoxicity, as well as cancers affecting the lungs, liver, stomach, and kidneys (Lundgren, 2012; Rushton, 2003).

While the aforementioned risks apply to the general populace, pregnant women and children represent a vulnerable subpopulation, as research has revealed that even placental tissue in women who live in Guiyu showed elevated levels of lead and other toxic heavy metals (Guo et al., 2010). In exposed fetuses, instrumental processes of cell differentiation and maturation may be affected—leading to premature birth, cognitive and behavioral impairment, and congenital malformations (Dietrich, 2010). The increased food intake per body weight of growing children and pregnant women heightens their susceptibility to environmental toxicants ("Electronic waste," n.d), while breastfeeding and hand-to-mouth behavior among very young children exacerbates their risk of exposure. In fact, over 80% of Guiyu children sampled in a study by Huo et al. (2007) were found to be at risk for lead poisoning—highlighting their vulnerability as children are less able to identify and appreciate threats from environmental contaminants such as particulate matter deposits on outdoor items and toys. Children are often employed at e-waste sites because their small hands are ideal for dismantling equipment (The Lancet, 2013); however, their smaller body size means they receive larger doses of toxicant relative to their body size and have difficulty processing and excreting them. (Heacock et al., 2016)

Policy

International Policy

The Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal (Basel Convention) is the United Nations treaty that was signed on March 22, 1989 and went into effect in 1992. The Basel Convention is meant to curb the movement of hazardous waste from high-income countries to low-income countries, largely spurred on by public outcry as awareness of the e-waste issue grew throughout the 1980's. With 187 countries party to the convention, the only nations yet to ratify this treaty are Haiti and the United States of America, meaning that they are not legally bound to any aspects of the convention. Since its inception the "Basel Ban Amendment" has been added to the treaty, which outright bans the movement of hazardous waste from Organisation for Economic Cooperation and Development (OECD) member states, the European Union, and Liechtenstein (or "Annex VII" nations) to less developed countries. Though having ratified the Ban Amendment, Ghana has not implemented or enforced it (www.basel.int). Criticism of the Basel Convention points out the ambiguous language of the agreements; prohibited trade is exempt between countries that come to a bilateral agreement to manage the e-waste in an "environmentally sound" manner, yet the Convention fails to define "environmentally sound" (Oteng-Ababio, M. 2012).

Domestic Policy

Ghana was the first country in Africa to adopt official guidelines and policies to sustainably manage e-waste. These policies include the Electronic Waste Control and Management Act (Act 917), passed in 2016, and the Technical Guidelines on Environmentally Sound E-Waste Management, passed in 2018. These guidelines support actors at every level of the e-waste recycling sector in Ghana in protecting public health (Sustainable Recycling Industries, 2018). Enforcement of Act 917 began on October 1, 2018, requiring importers of electronics and electronic equipment to pay a fee between \$.15 and \$15 per item, depending on the product. The money gained from this tariff goes directly to Ghana's E-waste Fund, which will "coordinate the disbursement of the money according to provisions contained in the Act" (WEEELogic, 2018). With these regulations just coming into effect recently, there is little to no literature shedding light on these policies' effectiveness. However, a recent focus group indicated that there have been gaps in e-waste law enforcement "partly due to political influence, poor attitudes of Ghanaians in waste handling and management, lack of resources from Government, and lack of innovation in the effective management of E-waste" (Quaye, Akon-Yamga, Asante, & Daniels, 2019).

These concerns have a historical precedent, as previous institutions and policies, including the 1991 National Environmental Action Plan and the Ghanaian Constitution itself commit the government to protecting both the natural environment and public health. A regulatory bill passed in 2010 prohibiting the importation, sale, and distribution of second-hand air conditioners, freezers, and refrigerators, but there was little to no enforcement of this policy (Amoyaw-Osei, et al, 2011).

Agbogbloshie

History of Agbogbloshie.

Agbogbloshie, one of the most widely known e-waste sites in the world, is located in Ghana's capital city of Accra. The site originated as a scrap metal recycling site, but in the past ten years, as the use of electronic devices increased in Africa and imports were accepted from industrialized countries, Agbogbloshie became an important location for e-waste recycling (Srigboh et al, 2016). Electronic waste that cannot be reused for its original purpose finds its way to the carts and sheds of recyclers in Agbogbloshie. Until recent years, the infrastructure and regulations necessary to safely manage e-waste recycling, especially in terms of environmental and human health concerns, were not in place, so outdated protocols like opening burning and mechanical shredding are still used. These practices put recycling workers at risk for many health problems (Asante et al, 2012). There is heightened concern for exposure to toxic elements like arsenic, lead,

mercury, and copper, which have been found in the soil, water, ash, sediment and dust collected from the Agbogbloshie site (Srigboh et al, 2016).

Efforts to contain waste effects have been made in the past, including the Korle Lagoon Ecological Restoration Project (KLERP), which began in 1999. KLERP aimed to restore the Korle Lagoon to its natural ecology after it had become one of the most polluted bodies of water on earth, as well as to involve the community in managing their environment through education programs. Due to the extended release of waste into surface drains, polluted water runoff filled the lagoon, and over time the abundant stock of fish ceased to exist, which was detrimental to both commercial use and recreation (Boadi and Kuitunen, 2002). Routine periods of flooding were also hazardous to the surrounding communities. The restoration project, which began in 2000, included dredging the lagoon of silted material, improving flood control measures, the construction of a sewage treatment plant, and a network of drains. Another component of the project included educating community members, starting with school children, about the importance of sanitation and environmental hygiene. This allowed the community members to have an active role in creating their own futures. Despite the high hopes for the project, the issues of political commitment, lack of resources, and inability of government officials to collaborate with slum residents led to the lagoon remaining heavily polluted.

Present-day situation.

Agbogbloshie borders the Old Fadama slum, which stretches along the Odaw River and Korle Lagoon. Around 80,000 people reside in Old Fadama, some of whom have immigrated to Ghana from nearby countries of Togo, Benin, Nigeria or Burkina Faso. The population of Agbogbloshie continues to rise due to the growth of the nearby markets, gentrification and displacement from other areas of Accra, a lack of planning and zoning regulations in the area, and rural-to-urban migration within Ghana. Agbogbloshie itself encompasses industrial, commercial, and residential areas, but is most well known as a dumpsite and scrap-metal yard. It was named one of the top ten toxic threats in 2013 by Pure Earth, an international non-profit organization dedicated to solving pollution issues in low- and middle-income countries (Pure Earth, n.d.; Amoyaw-Osei, et al, 2011).

While there is general agreement that trash management, and specifically e-waste, is a serious issue in Agbogbloshie, few agree on the numbers. For example, Agbogbloshie is currently the world's second largest e-waste dumpsite; however, where that waste comes from is often misunderstood. In an article for the Smithsonian Magazine, Minter (2016) describes how Agbogbloshie became the symbol of a growing crisis of exporting electronic waste even though "85 percent of the e-waste dumped in Ghana and other parts of West Africa is produced in Ghana and West Africa" according to the United Nations Environment Programme. Feldt et al. (2013) reported 2011 numbers from the E-waste Africa Programme that say Ghana imports about 215,000 tons of used

consumer electronics from Western Europe and generates 129,000 tons of e-waste every year.

In environmental studies conducted around the area, lead levels ranged from 134 ppm to as high as 18,125 ppm among sampled soil. Over half of the sampled soil exceeded 400 ppm, the United States Environmental Protection Agency's standard lead level for soil (Caravanos, Clark, Fuller, & Lambertson, 2011). The unfortified ground on which recycling activities in Agbobloshie typically take place allows hazardous chemicals to discharge directly into the soil. Levels of antimony, cadmium, tin, zinc, copper, and lead in Agbogloshie soils have been found to be over one hundred times the levels in typical background soil (Amoyaw-Osei, et al, 2011). According to Pure Earth (n.d.), the estimated number of people at risk for lead exposure is at 40,000 people.



3: Onion market in Agbobloshie area of Accra, Source: Adam Minter

Team Assignment

Efie went into the GHANA office that morning and proposed that the team apply for the United Nations Environment Programme (UNEP) grant, focusing on the issue of e-waste & its health impacts in Agbogbloshie. The Executive Director of GHANA has approved this initiative, and your team has until Saturday morning to craft a proposal to the UNEP. The parameters of this grant include:

- Timeline: 5 year-maximum
- Funding: \$2,000,000
 - Some measure of funding must go into policy advocacy, but no more than 50% of the funding may contribute to advocacy efforts
 - **At least** 50% of the funding **must** be used for (a) direct public health intervention(s). A higher portion may be allocated, but no less than 50%
 - Your presentation should include a clearly delineated budget for use of the UNEP funding
- Explain your strategies in a concise 15-minute presentation, followed by 5 minutes of Q&A

Proposal presentations will be viewed and scored by a panel of judges on Saturday, November 2nd. The top 3 presentations will advance to the final round.

After viewing your presentation, judges should be able to answer the following questions:

1. Why should UNEP fund a proposal on this topic?
2. What health intervention will have the most impact and why?
3. What policy advocacy strategy or plan will have the most impact and why?
4. What is your budget and how is it split across programs?
5. Across your interventions, what are your specific plans to address:
 - a. E-waste supply
 - b. Issues of e-waste contamination of water and air
 - c. Health impacts of e-waste contamination
 - d. Lack of recycling infrastructure and waste management
 - e. Enforcement of recent legislation like Act 917

Important areas of consideration for your proposal:

- Choice of Target Population: Who is the target population and why did the team choose to target them?
- Social Benefit/Social Return on Investment: Impact on health outcomes, economic improvement, and productivity at the personal, family, and community levels
- Feasibility: How well do the proposed strategies utilize and/or improve capacity of current health systems, training/education required to implement plan, what provisions for education, product, or service delivery?
- Economic Impact: Direct costs associated with proposed strategies; transportation and/or opportunity costs to stakeholders
- Cultural Acceptability: Cultural perceptions of the proposed strategies and the extent to which they have taken in local cultural context and technologies
- Legal and Ethical Issues: Strategies for how these will be addressed, if applicable
- Scalability: Application of recommendation to other communities or more extensive coverage beyond Agbogbloshie, provided there is evidence of success
- Sustainability: Plans for how the program will proceed once funding ends
- Monitoring and Evaluation: Comparison of baseline data, to data collected during and after proposed intervention(s) and how this information will be used to inform program improvements and demonstrate impact
- Risk Identification & Mitigation Strategies: Potential challenges/risks associated with recommendation(s) and how those will be addressed
- Innovation: Are there aspects of the proposal which could be considered particularly innovative or creative; novel application of existing technologies or new products/services proposed?

Resources to support your intervention development:

- ✎ Tuesday, October 29th | 11am – 12pm | The Edge of Chaos
“Managing Waste and Protecting Health” Seminar with Dr. Lisa McCormick
- ✎ Wednesday, October 30th | 5pm – 7pm | The Edge of Chaos
Policy Advocacy Workshop with Sean McMahon
- ✎ The [Ghana e-Waste Country Assessment](#) by Amoyaw-Osei et al. is a recommended resource with the caveat that you keep in mind the assessment is from 2011.

Attachments

Figures 2 & 3: Maps of Ghana, Source: [World Atlas](#)



Figure 4-5: Maps of Agbogbloshie and surrounding areas, Source: Amoyaw-Osei et al., 2011



Figure 6: Agbogbloshie scarp yard – detail map, Source: Amoyaw-Osei et al., 2011



Figure 7: Select causes of mortality in Ghana, 2017, Source: [IMHE](#)

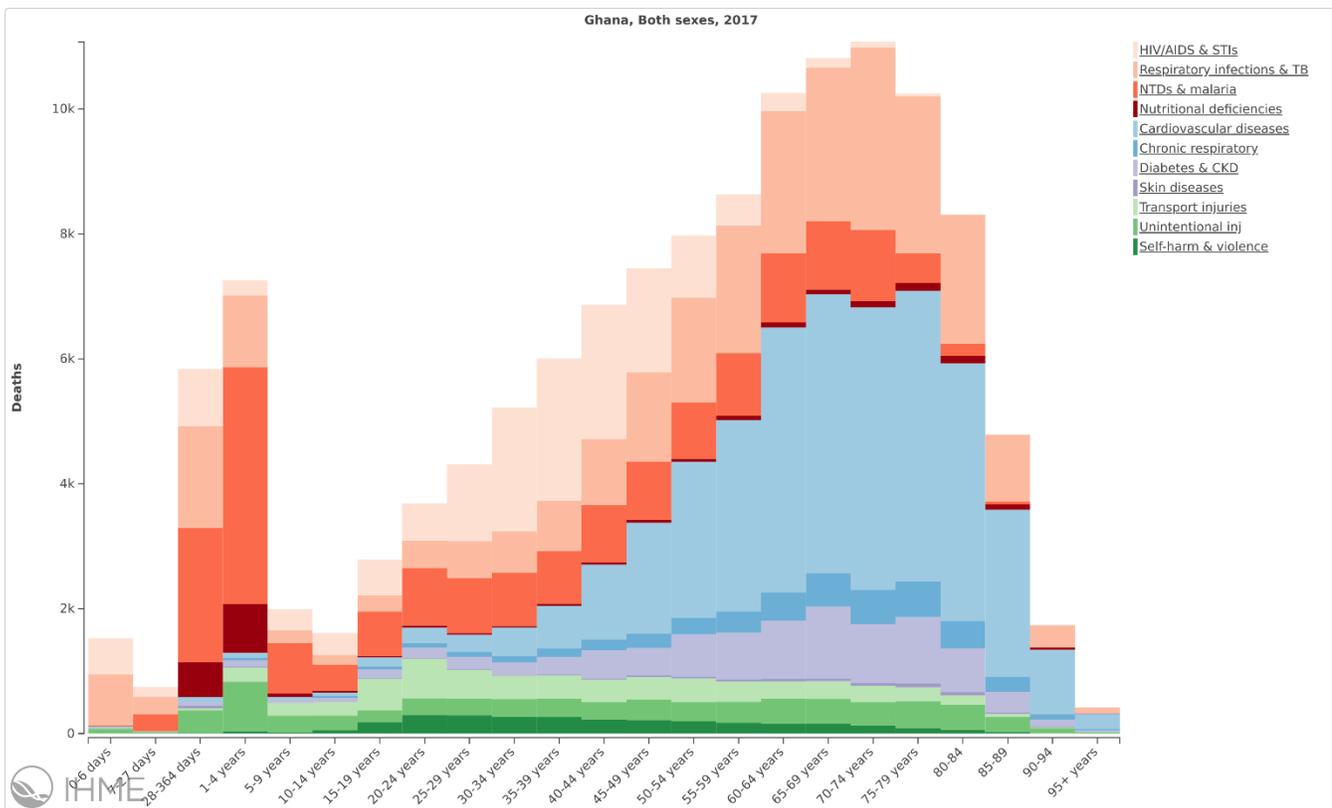


Figure 8: Composition breakdown of applications & electronics (in tons),
Source: Amoyaw-Osei et al., 2011

Material	Large Household Appliances	Small Household Appliances	ICT and Consumer Electronics	All of EEE
Total Tons	689'000	198'000	446'000	1'333'000
Ferrous metal	296'000	57'000	161'000	514'000
Aluminium	96'000	18'000	22'000	136'000
Copper	83'000	34'000	18'000	135'000
Lead	11'000	1'100	1'300	13'000
Cadmium	10	13	80	103
Mercury	0.3	0.04	0.3	0.6
Gold	0.005	0.001	1.1	1.1
Silver	0.05	0.01	5.4	5.4
Palladium	0.002	0.000	0.3	0.3
Indium	-	-	2.2	2.2
Brominated plastics	2'000	1'500	80'000	84'000
Plastics	131'000	73'000	54'000	258'000
Lead glass	-	-	85'000	85'000
Glass	100	300	1'300	2'000
Other	69'000	14'000	25'000	108'000

Shaded = hazardous or possibly hazardous fractions

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