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MANAGEMENT OF E-WASTE, A COMPARATIVE STUDY FOR SUITABLE STEPS WITH SPECIAL REFERENCE TO PROTECT ENVIRONMENTAL AND PUBLIC HEALTH

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INTRODUCTION:

It is impossible to imagine life without smartphones, GPS navigation systems, laptops, and other digital devices because technology has grown so swiftly in recent years. At the same time, environmental activists, municipal and state governments, and even the United Nations are seriously concerned about how to reduce e-waste due to the quickly rising number of used electronics being wasted. Electronic waste, or "e-waste," is a severe problem. Waste management in India has much room for expansion because currently, only 30% of the country's recyclable trash—which accounts for 75% of all waste—is recycled. The country's waste management is inefficient for various reasons, including a lack of efficient legislation for collecting, storing, and recycling garbage and outdated infrastructure.

E-waste management trends recently:

The National Strategy for Electronics Stewardship of the Environmental Protection Agency is the basis for new regulations and strategies for producing and recycling electronic devices. Among the proposed or adopted changes are a focus on a zero-waste, linear economy, a targeted vulnerability to cybersecurity to enhance system destabilization methodologies, and an overall focus on proper e-waste recycling accreditations, employees' rights, and ecological oversight for established service companies.

There are still barriers to efficient waste management, including a lack of investment, infrastructure, and consumer education, even though the Ministry of Environment, Forestry, and Climate Change (MoEFCC) released the E-waste laws in 2016 and followed them with updates. Several entrepreneurs and companies have come to India to help the unofficial sector gather, process, and recycle electronic waste.

Startups have begun to get involved in various endeavors, including e-waste disposal, credit monitoring, logistics and distribution, data security and disposal, CSR initiatives, and renovation, all with a sincere belief in the three R's of sustainability. They separate the trash into glass, plastic, and metal pieces. Then they process all the dangerous substances and send the remainder for extraction. The remaining metal and plastic are given to recyclers.

Environment, public health, and e-waste:

Electronic garbage is now the fastest-growing component of the conventional municipal solid waste stream, and its disposal is becoming a concern for both public health and the environment on a global scale. Any electronic or electrical device discarded, surplus, outdated, or broken is considered e-waste. Due to a lack of knowledge regarding safe disposal, most obsolete electronic devices are stored in homes. In addition to being incredibly complex, this ever-growing waste is a rich supply of materials, like copper, silver, and gold, that may be recovered and used again in manufacturing. According to a study by allied market research, the value of the worldwide e-waste management segment was $49,880 million in 2020 and is projected to increase by 14.3% CAGR from 2021 to 2028 to reach $143,870 million by that time. The market expansion for rare metals and their scarcity has caused a significant rise in their price.

Management and Disposal of E-Waste:

Regarding e-waste reduction, it is not only about lowering environmental risks. Recycling parts from e-waste requires much less energy than creating new ones, reducing the resources and energy needed to produce these items.

PERCEPTIONS OF FEW PROFESSIONALS AND INSTITUTIONS:

- China, India, and the US calls global e-waste "unsustainable." – UN reports
- Electronic Waste: A Growing Concern in Today's Environment – Hindawi, Ecnomics Research International
- E-Waste Shouldn’t Be Waste – School for International Training
- Focus on E-Waste recycling - India PM Modi in Mann Ki Baat
- World is on track to generate 74 mn metric tonnes of e-waste annually by 2030 – Firstpost
- It goes green, all products use recycled materials - Google

- How e-waste can produce more gold than mining – The Economic Times, India
- How companies and startups are using three 'Rs' of waste management to tackle global challenges – Financial Express
- We have made a commitment to zero waste across its direct waste footprint by 2030 – Microsoft
- The company directed more than 38,000 tonnes of e-waste to recycling globally in 2021. We aim to eliminate all plastic from its packaging by 2025 – Apple

REVIE OF LITERATURE:

There are many strategies to reduce and manage e-waste, some of which are listed below:

Buying things we do not need is the leading cause of electronic waste. Buy new electronics that can be reused or discarded by the manufacturer. Choosing recyclable or durable electronic items is a sustainable step in the management of e-waste.

Sort through our belongings.

We will never know what we have if we do not arrange our DVDs, cables, connectors, and electronics. The last thing we want is to purchase something we need to find that we already have a copy in our cabinet.

Donate or distribute our electronic garbage:

Donate anything we do not need so that it might be enjoyed by someone else. Donations are excellent tax deductions since the sum is typically close to the asset's value if sold.

Donate them to the shop:

By creating a buy-back program, a contract between the consumer and the seller implies the seller has promised to buy back the object that was sold eventually. A few stores do offer this. Check with the shop to

see whether they will buy our old camera, computer, or other stuff before we head out and purchase a new device.

Trade-off unused items:

When we no longer need our devices, sell them immediately because the value of newer ones decreases quickly. Many organizations will gladly purchase our used fitness bands, wearables, gaming consoles, computers, video cameras, and other devices. They offer their services for "cash in exchange for goods."

No matter where we live, check out the recycling options and tell our neighbors and relatives about them. For instance, the Environmental Protection Agency's website details nearby alternatives for recycling electronics if we reside in the United States.

Imagining the future:

E-waste cannot be eliminated quickly; we must do so sooner or later. So why not make money off of it now? Keep them from building up. Due to the rapid advancement of technology, electronic devices have become dated more quickly than they formerly were. Therefore, it is essential to sell any outdated electronics to minimize clutter and loss in the future. Data storage on the cloud is now possible.

Purchasing a large server or other power equipment for business or personal storage is unnecessary. Cloud data platforms are the best for preserving and syncing our information across several devices because they do not require a server. Get as much knowledge as we can and feel some fear.

Disposing of electronic equipment correctly is essential because most contain dangerous components. Educate ourselves, our kids, and the people in our social circle. These substances should raise our awareness of the risks associated with e-waste.

Conserve what we have:

We can extend the usefulness of what we already have by making small changes. Cleaning our computer sometimes and not overloading it will help our battery last longer. Regular servicing and maintenance can significantly increase the longevity of electronic products. Be aware of security issues and dispose of personal computers and cell phones at recycling facilities.

The fact that all of our personally identifiable information is preserved on electronic devices even after we wipe it is another justification for keeping them. Recycling facilities may thoroughly clean our device before recycling it, guaranteeing those cybercriminals cannot access the data.

Inform our kids about electronic waste:

Kids are our legacy, so it is best if we can instill a commitment to recycling e-waste in them from a young age.

It is crucial to consistently reiterate that outdated models should be recycled rather than tossed because we know that consumers will keep buying new products. We are putting the environment in peril if we throw away our technology. On the other hand, there are several environmental benefits to recycling. Alternatively, we can donate such items to a reliable business with years of experience recycling electronic equipment sustainably.

E-waste Reduction Is Vital:

These devices employ rare materials, which makes their development and manufacturing a significant source of embodied energy. Reduced energy use and resource consumption are two benefits of reducing e-waste.

Reusing precious metals and polymers from obsolete cell phones alone rather than producing or mining more would result in energy savings equivalent to turning off the electricity to 24,000 US homes annually. The average American home has 24 electronic devices, and according to an EPA estimate from 2009, 2.37 million tonnes of electronics are just waiting to be thrown out. It could fit inside nearly five football stadiums!

Re-evaluate. Do we require that different device? A single device with several uses might be possible. Ensure the longevity of our electronics. Purchase a case, keep our gadget tidy, and refrain from charging the battery too much. Consider purchasing green electronics. Keep an eye out for products with Energy Star or EPEAT certifications.

Donate used gadgets to social programs to support causes related to the environment, protecting children from harm and domestic violence. Request an ink or mobile phone postage-paid mailer from our student REP. The World Wildlife Fund will get one dollar for each thing it receives. E-waste recycling boxes may be found all over campus. Recycle devices and batteries there. The larger containers in our building can be used to store bulky electronics.

FIVE SAFE DISPOSAL METHODS FOR ELECTRONIC WASTE

New products and devices are occasionally introduced by new technology. So what do we do with our outdated technology?

Where Do We Throw Away Electronic Waste?

Lead, cadmium, beryllium, mercury, and brominated flame retardants are only a few hazardous substances in all electronic waste. It increases the likelihood that these hazardous compounds will contaminate the earth, pollute the air, and leak into water sources when gadgets and devices are disposed of illegally. When electronic waste is dumped in a landfill, it often leaches when water travels through it and picks up trace metals. If the contaminated landfill water gets into any drinking water, it could be dangerous because the toxic levels in the natural groundwater have escalated by the time it reaches it.

Despite taking an environmentally beneficial approach, recycling frequently results in shipping the devices to other countries and their disposal in pits. Even worse, some recycling businesses export e-waste to developing nations while passing it off as philanthropy. Many young people in these nations make a living by stealing copper, iron, silver, and gold from toxic tech waste, which is terrible for their health. Countries utilized as garbage dumps typically have high incidences of cybercrime because salvaged hard drives allow hackers direct access to our data and information.

We can dispose of electronic garbage locally using some of the following environmentally responsible methods:

A Certified E-Waste Recycler Should Receive our Electronic Waste:

We must locate an e-waste recycler that has received formal recognition from the Basel Action Network (BAN). E-waste recycling safely and responsibly is the goal of BAN, a non-profit association of recycling businesses. The Pledges of Responsible Recycling must be signed by each member and displayed. Working with a licensed recycler eliminates the danger of damaging another country or giving thieves access to our personal information.

How to Protect Our Electronics Before Donating or Recycling:

Instead of just replacing it, upgrade our computer:

Before throwing away our products, format all of the personal information on them.

Before discarding our devices, remove the batteries from each one.

Offer Up Our Old Technology:

The adage "one man's trash is another man's treasure" is true. We can use this strategy to dispose of our outdated electronics. We may use online marketplaces like Craigslist and eBay or even hold a garage sale to get rid of our old equipment and make some cash. Old Nintendo video games are an example of this, and they may sell for up to $40 each. Most electronic stores are constantly willing to buy our used equipment.

Providing Old Technology for Charity:

Old technology we no longer need can be donated since it can be valuable to someone else. Students or an NGO might find a use for our old PC. Before getting rid of our old equipment, consider these two questions.

The electronic device is operational:

Does the computer include any of our private data?

Several organizations and companies offer electronic donation programs from which to pick.

Explore civic institutions:

As many organizations have begun designating a specific day and location for environmentally aware residents to come and drop off their e-waste, ask our government, universities, and schools whether they operate any recycling programs.

Repay Our Electronics Companies and Drop-Off Locations:

When we buy a newer model of an electronic device, many companies have an exchange program whereby they accept our old ones and, occasionally, give us a discount on the new one. A few recycling businesses have set up drop-off locations for products like cell phones and tablets, as well as electronic drop-off efforts. We can inquire about drop-off locations at our neighborhood electronics stores.

Protect both the environment and our private data:

Today, electronics play a significant role in our lives, but there is a downside: e-waste. Because the repercussions of not formatting our electronic devices before properly disposing of them might be harsh, be sure to do so. In China, electronic garbage is piled high. While some of it can be recycled, the majority is waiting to be sent to e-waste sites in Africa or other regions of Asia.

While recycling metals, glass, and plastics has become commonplace, electronic waste is given far less consideration. Any outdated or unwanted electronic item is called "electronic waste." Electronics categorized as e-waste may need to be in better functioning order. E-waste that is not adequately recycled causes air, soil, and water contamination, which in turn may impact people and wildlife. 80% of the world's electronic garbage is still in this state, and only 20% is recycled yearly (source).

Consider how regularly individuals replace their outdated mobile phones with newer models or how often they swap their old TVs for newer, sleeker models. It should come as no surprise that e-waste has emerged as a significant issue given the speed at which technology is evolving, the increase in discretionary wealth, and the accessibility of electronic products.

How to Cut Down on Our E-Waste:

According to Do Somethingsomething, between 20 and 50 million metric tonnes of e-waste are disposed of annually. The unfortunate fact is that just 12.5% of it is recycled. Even worse is that most consumer electronics function excellently or can be reused. Most gadgets, including batteries, TVs, tablets, memory sticks, computers, and cell phones, end up in landfills and contribute to water and air pollution. Keeping electronic trash to a minimum is one of the best ways to protect our environment. The good news is that lowering our e-waste is pretty simple.

Donate or market functional electronic:.

Selling our functioning devices is one straightforward approach to managing e-waste effectively. Through Craigslist or eBay, we might locate a buyer. Many of these customers will utilize or sell the items or the parts. Alternatively, we can send our old electronics to be successfully recycled or repurposed using comparison and recycling websites, which will offer us a price. Cell Phones for Soldiers are an excellent alternative. In order to lessen the burden on landfills, Cell Phones For Soldiers has recycled more than 20 million cell phones since 2004.

Less Consumption:

Reduce is the most crucial of the three "Rs" (Reduce, Reuse, and Recycle). A stylish TV, the newest smartphone, or a brand-new laptop are all straightforward. Most individuals do not even pause to consider whether they truly need them. Consider whether we need anything before making a purchase. Why not upgrade the software instead of purchasing a new device if our old one is still in good working order? Our aging laptop can be repaired at our neighborhood computer store. Managing our household's e-waste effectively starts with being a responsible consumer.

Use an outdated mobile phone for GPS or music.

Most individuals replace their outdated phones with new ones once a year. Consider using it for another purpose rather than letting it collect dust in the desk drawer or trashing it. It may be used as a GPS unit or music player while being kept in our car. Boat owners frequently store an outdated smartphone on board as a backup GPS. Old phones can be used to control universal remotes or to see security cameras.

Recycle through a Store:

Major brands and merchants provide recycling choices online, in-store, and drop-off locations. Computers, smartphones, and televisions are all recycled. Some even let us exchange our outdated equipment for gift certificates. Ask the store if they offer a repurchase program before making an electronic purchase. Customers generally have many choices at large retailers.

Look up E-Cycling Facilities in Our State

Giving all of our unwanted equipment to free sites is one approach to cutting down on our e-waste. Local volunteers serve as group moderators in their local groups. It is free to join. We might also gather our electronic waste once a month and donate it to an e-recycling facility in our state.

Make Our Electronics Organised:

Given the electronics we store in drawers and cabinets, we need to remember what devices we have in our homes. Organize our current equipment to determine whether we need to replace it before buying new ones. For instance, we might require a memory stick but find that we already have one not utilized after organizing our equipment. Try to share devices, cords, and connectors among family members rather than purchasing the same item or charger often.

The Battery Disposal Laws in Our State Should Be Known:

Some governments have made it unlawful to dispose of away rechargeable batteries in the trash because they contain hazardous materials. The good news is that these batteries' components, lead, plastic, and metal, are all easily recyclable.

Online Data Storage Made Secure:

Why use a memory stick or other gadget when we can readily save considerable material online? Online cloud storage services like Dropbox and Google Drive (both free) are available in various configurations. We can test out a few paid services for a free 30-day period to discover which suits us best.

Purchase energy-efficient equipment:

The Energy Star Programme from the Environmental Protection Agency offers refunds when we recycle old appliances and purchase new Energy Star ones. Not only are Energy Star appliances environmentally beneficial, but they also use less electricity, which lowers our monthly electric costs. Choose Energy Star models the next time we buy a washer, a dryer, a microwave, or an air conditioner.

Learn About the Materials Used in Electronics:

Investigate the raw materials used to make our laptop, dishwasher, or mobile phone, last but not least. While certain raw materials are simple to recycle, others are not. Several hazardous compounds are also present in

gadgets. Our ability to make long-term purchases of products that will not hurt the environment will improve as we get more knowledgeable. Before we sell, give away, or donate our mobile device, remember to wipe the memory and do a factory reset. It can benefit the environment if we are more aware of the electronics we use and the part we can play in e-waste reduction.

Old Hard Drives: What to Do?

These are the three most practical options for disposing of outdated hard drives:

Repurpose: If the hard drive is still in good shape, we can use it again as an external hard drive. Here is a video demonstrating how:

Sell - Wipe it clean, just like we would any other device that might hold our data or pictures (or data about your business). Achieve complete file deletion or status restoration. Call them to determine if our neighborhood computer repair company buys and refurbishes used hard drives. A quote can also be obtained online.

Recycle - Cohen USA claims that all hard drives, internal and external, are recyclable. We can recycle the entire device or, in certain situations, only the hard drive.

An award-winning publication focused on conscious living and natural parenting has been produced by Green Child since 2010. Green Child has developed into a valuable resource for parents concerned with reintroducing simplicity, compassion, social responsibility, and instinctive intelligence to parenting. It was once described as "good for a green mama's soul."

Green activism, recycling, and technology are filed under Organisation and Green Living.

Earlier:« Guided Relaxation: Enchanted Autumn Forest

Eco-friendly Halloween Decorations Made of Natural or Reusable Materials

A compost bin is advisable because it is a much more environmentally friendly way to dispose of our trash. Suppose we need more space for a compost bin. In that case, we can also consider hiring a junk removal service like Junk Call, which will come to our home, remove our waste, and then dispose of it in an environmentally responsible way. Due to rising disposable income levels, growing urbanization and industrialization, and population expansion, electrical and electronic equipment (EEE) is in greater demand today.

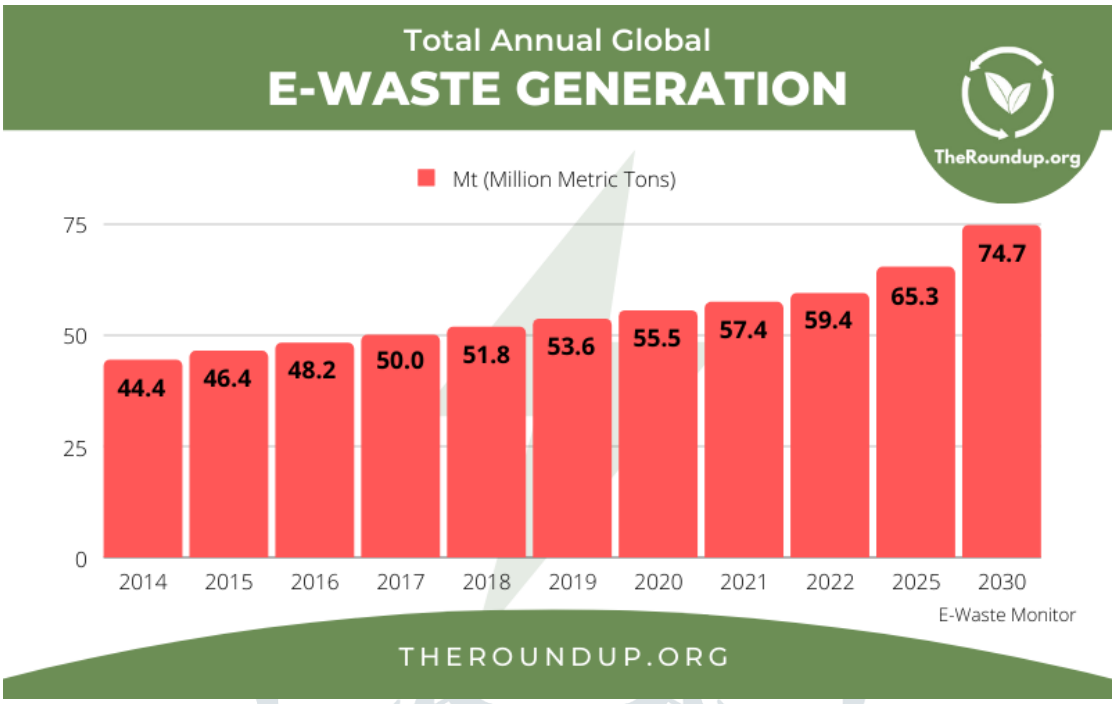
A significant amount of EEE has a brief lifespan and is frequently considered expensive or difficult to replace. While older technology may still be functional, brands spend billions to make consumers want the newest ones, making it obsolete and unwelcome. After being used, EEE is discarded and turned into electronic garbage, often known as e-waste.

E-waste comprises a mix of recyclable, valuable components typically not recycled and toxic compounds like lead, mercury, and cadmium that can harm human health and the environment. The extent and effects of the global e-waste problem will be demonstrated by the most recent research, data, and statistics that we will share in this article.

E-waste production reached 57.4 Mt (Million Metric Tonnes) in 2021. An average of 2 Mt are added to the amount each year. By 2022, the amount of electronic waste that has yet to be recycled will be above 347 Mt.

- The biggest producers of e-waste are China, the US, and India.
- The amount of known collected and correctly recycled e-waste is only 17.4%.
- The highest e-waste recycling rates are found in Estonia, Norway, and Iceland.
- The market for recycling e-waste was estimated to be worth $48,880 million in 2020.

Statistics of E-Waste Production:



How much e-waste is created annually?

Global e-waste production in 2021 is predicted to have reached 57.4 Mt (million metric tonnes).

Since 2014, when data on e-waste began to be gathered, there has been an increase annually.

How Much E-Waste Is There on Earth?

The total amount of e-waste generated but not recycled is still being determined. It is possible to approximate, though, using our most recent information.

According to data collected since 2022, an estimated 420.3 million metric tonnes of e-waste would have been produced by the end of 2014. We also know that a small portion is often recycled. It allows us to calculate that there is still at least 347 Mt of electronic garbage.

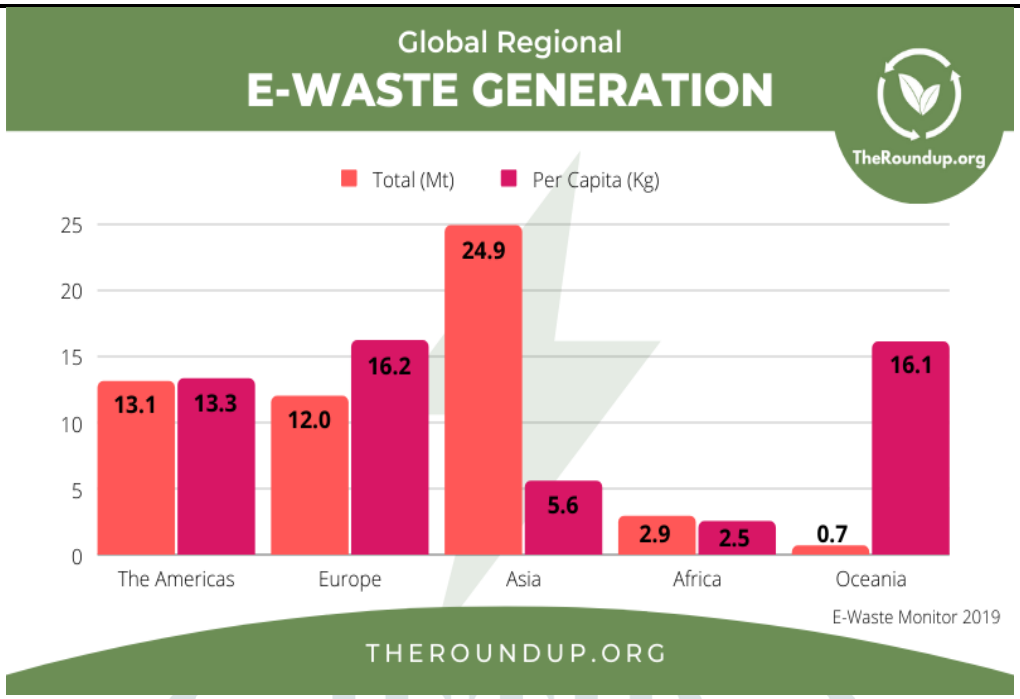
Due to the following factors, this estimate is most likely conservative:

Before 2014, there will have been a substantial amount of e-waste generated (and not recycled). Not every piece of created e-waste is recorded. The amount of waste recycled has changed over time, and it may have been less initially before the subject was brought up internationally and more nations passed laws allowing for appropriate recycling.

Will there be an increase in e-waste in the future?

Over the past ten years, the creation of e-waste worldwide has risen by 2 Mt yearly.

By 2030, it is anticipated that the volume of electronic trash generated worldwide will increase to 74.7 Mt, nearly doubling in just 16 years.



Which Area Generates the Most E-Waste in Volume?

Rank	Country	E-Waste Produced (Kt)	Recycling Rate
1	China	10129	16%
2	USA	6918	15%
3	India	3230	1%
4	Japan	2569	22%
5	Brazil	2143	0%
6	Russia	1631	6%

7	Indonesia	1618	n/a
8	Germany	1607	52%
9	UK	1598	57%
10	France	1362	56%

By weight, the three regions that created the vast bulk of E-Waste were Asia (24.9 Mt), the Americas (13.1 Mt), and Europe (12 Mt). The area with the highest per-capita production of e-waste is. Europe produces the highest e-waste per person, at 16.2 kilograms, followed by Oceania (16.1 kilograms) and the Americas (13.3 kilograms). The least quantity of electronic garbage is generated per person in Africa.

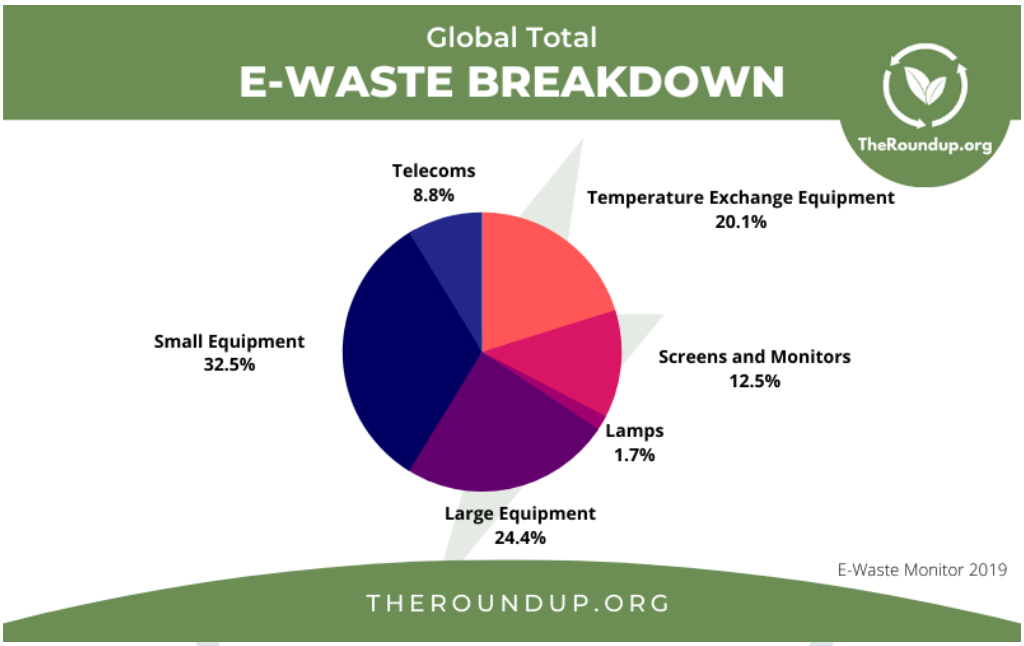
Which nations generate the most e-waste?

Most electronic waste is generated in China, the US, and India.

According to the overall volume produced (represented in KiloTons), the table below lists the top 10 e-waste-producing nations in the world.

We may also view the individual recycling rate for each of the top 10 nations based on the most recent statistics (updated November 2022).

Data on the makeup of e-waste

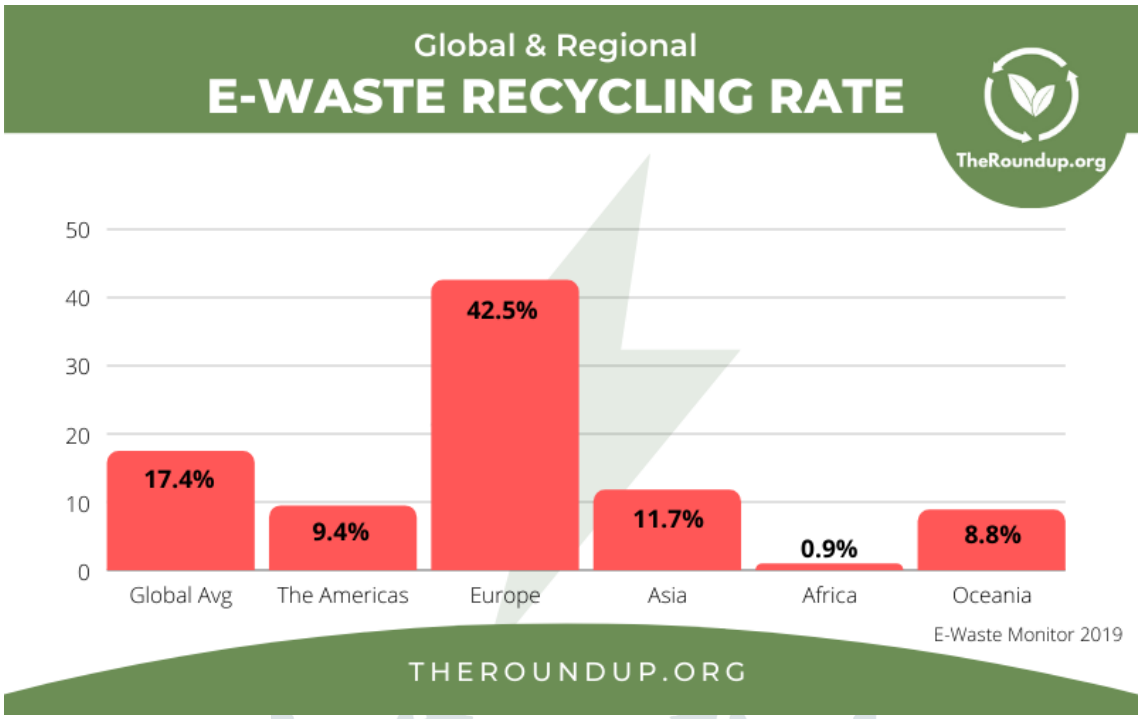


What Are the Most Popular E-Waste Products?

Among the components of the 53.6 Mt are the following:

Small appliances weighing 17.4 metric tonnes, such as microwaves, fans, kettles, toasters, shavers, hairdryers, radios, tools, and toys. 13.1 Mt of large equipment, which includes dishwashers, ovens, cooktops, and washing machines. Refrigerators, freezers, air conditioners, and heat pumps totaling 10.8 Mt in temperature exchange equipment. Televisions, monitors, computers, notebooks, tablets, and other screens totaling 6.7 Mt. Mobile phones, phone covers, wireless routers, GPS devices, and pocket calculators are among the 4.7 t of small IT and telecoms equipment. 0.9 Mt of lighting, including LEDs. Only one of these categories, screens, and monitors, has shown a decline in manufacturing since 2014, primarily due to the discontinuation of older, heavier displays.

Statistics on E-Waste Recycling:



How Much of the Electronic Waste Is Recycled?

Globally, less than 1/5 is recycled, though this varies by area.

Only 17.4% of the world's total e-waste has been known to be adequately collected and recycled. This number has decreased during the last five years in terms of total waste produced.

The highest percentage of e-waste is recycled in Europe.

At 42.5%, Europe has the highest recycling and waste collection percentage. With a rate of just 11.7%, Asia came in second. With a mere 0.9%, Africa has the lowest.

Which nation recycles electronic garbage the best?

According to the most recent data, Estonia, Norway, and Iceland have the highest rates of electronic trash recycling relative to the amount of waste each nation produces.

Rank	Country	E-Waste Recycled (Kt)	Recycling Rate
1	Estonia	13	76%
2	Norway	99	72%
3	Iceland	5	71%
4	Sweden	141	70%
5	Austria	116	69%
6	Switzerland	123	63%
7	Finland	65	61%
8	Poland	246	60%
9	Ireland	52	59%
10	UK	871	57%

The top 10 e-waste recycling nations are rated according to the proportion of their garbage legally collected for appropriate recycling. The total amount recycled (in kilotons) is also displayed for comparison.

Unknown What Happens to Non-Recycled Electronic Waste:

Since 82.6% of electronic waste is not recycled (via authorized means), it is not recorded. Where it goes after that is challenging to pinpoint for researchers.

Approximately 8% of e-waste is thought to be thrown away in the trash and then either landfilled or burned. It primarily comprises smaller electronic and IT devices like tablets and mobile phones.Up to 20% is considered exported as used goods or as rubbish.

More legislation is in place, but it is only sometimes implemented:

By the end of 2019, e-waste policies, laws, or regulations were in place in 78 nations. Compared to just 44% five years prior, this covered almost 71% of the world's population. However, in certain nations, applying the law could be better.

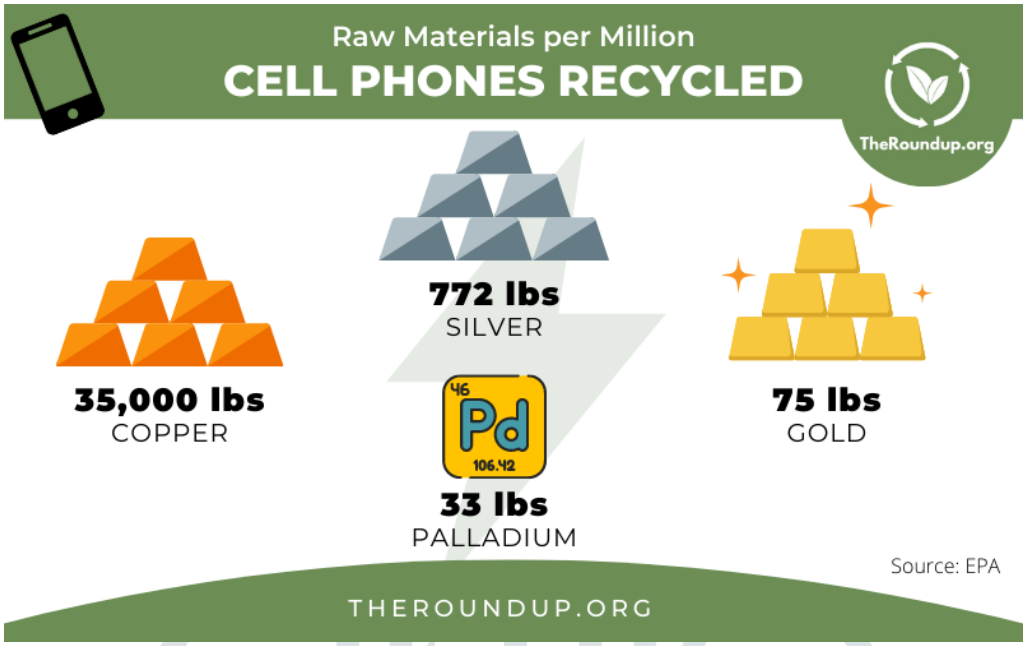
Additionally, no laws governing the recycling of e-waste are in place in 25 US states, including Arizona, Colorado, Florida, Georgia, Massachusetts, and Nevada.

A Lucrative Market Is Managing E-Waste:

Many precious and rare raw elements are present in e-waste, most of which are not recovered. Due to economic and environmental factors, the worldwide e-waste management market is anticipated to expand. The market had a value of $49,880 million in 2020, and by 2028, it was expected to quadruple to $143,870 million nearly.

E-Waste And The Environment: The Impacts of Not Recycling

Although its fate has not been confirmed, estimations imply that most unrecorded electronic garbage is combined with other debris, like plastic and metal. Therefore, although easily recyclable pieces might be recycled, it must be done correctly. No measures will be taken to eliminate harmful materials, and many more worthwhile recyclable components may be overlooked. E-waste needs to be recycled separately for this reason.



The Loss of Priceless Raw Materials:

E-waste contains several high-value raw elements, including copper, iron, gold, and silver. When one million obsolete cell phones are recycled, 772 lbs of silver, 35,000 lbs of copper, 75 lbs of gold, and 33 lbs of palladium can be obtained. According to estimates, the 53.6 Mt of electronic waste produced in 2019 contained raw materials with a market value of about $57 billion. Given that 82.6% of electronic waste was not recycled, that equates to valuable metals worth nearly $47 billion that was never recovered.

The Biodegradability Of E-Waste:

E-waste does not biodegrade. Thus, it will collect everywhere it is thrown, much like plastic garbage. Any greenhouse gases in the e-waste will slowly escape into the environment over time.

Hazardous Substances from E-Waste Pollute the Environment:

The environment and the health of people or animals who come into contact with e-waste are negatively impacted by its harmful substances, such as mercury and BFR plastics. When incorrectly disposed of, These compounds harm ecosystems and human populations because they can be discharged into the air, soil, or water over an extended period.

E-Waste Is a Climate Change Cause:

Without recycling, new raw materials are needed to produce new EEE. Every electrical product that is made leaves a carbon footprint. Greenhouse gases are produced during the extraction and processing of the materials needed to make EEE. If electronic waste was recycled, this might be minimized or avoided. Additionally, the refrigerants used in temperature-control EEE, like refrigerators and air conditioners, are greenhouse gases. Fridges and air conditioners no longer use 2019-emitted CO2 equivalents that makeup about 0.3% of all energy-related emissions.

A little-discussed but fundamental worldwide problem is electronic trash. It wastes valuable resources, causes climate change, is bad for the environment, and is terrible for people's health.

Furthermore, worst of all, it is pointless. Each of us can contribute to solving this problem on a personal level. Our decisions can have a tremendous impact if we live a more environmentally friendly lifestyle.

First and foremost, proper EEE disposal is required.

We all live in industrialized nations with access to facilities that will recycle our used electronic devices. It is either due to a lack of information or laziness that so many individuals do not do this.

The second approach is to choose sustainable products.

As we have seen, most of the world's e-waste comprises tiny objects. Decide to buy a sustainable electric toothbrush with recyclable heads or buy an eco-friendly phone case rather than a plastic one. Please pay attention to what we purchase, how we use it, and how we get rid of it when it ultimately reaches the end of its useful life.

Thirdly, resist the need to throw out outdated technology so quickly.

Many things can be fixed rather than replaced, frequently for much less money than buying a brand-new item. Also, remember that we can extend the lifespan of our electrical appliances by using them less frequently and more carefully. The one issue we can address independently, independent of businesses or governments, is e-waste. Let us each contribute in our way. Our children will appreciate it, as well as their offspring.

UN report citing China, India, and the US calls global e-waste "unsustainable."

Seelampur, a grey area in Delhi, depends on the broken or outdated electrical and electronic products that modern customers toss into landfills. Seelampur is located across the river from the Red Fort. At a salvage yard in Ahmedabad, India, on July 2, 2020, a scrap dealer stacks abandoned TVs before disassembling them. Seelampur, home to one of the biggest e-waste markets in the world, is a prime example of the issue mentioned in a study published on Thursday by the UN. A record 53.6 million tonnes of e-waste were discarded globally in 2017, according to the Global E-waste Monitor 2020 study. 17.4% were recycled. The report stated that "even countries with a formal e-waste management system are faced with relatively low collection and recycling rates."

The United States came in second with 6.9 million tonnes, and China came in first with 10.1 million tonnes of e-waste. With 3.2 million tonnes, India came in third. Nearly 38% of the global e-waste generated last year came from these three nations combined. The report concluded clearly: "How we produce, consume, and dispose of e-waste is unsustainable." However, the overall environmental harm caused by all the non-recycled garbage may be immeasurable.

The report cites several problems, including global warming, noting that improper recycling of "undocumented" refrigerators and air conditioners resulted in 98 million tonnes of carbon dioxide equivalents being released into the atmosphere.

Lockdowns due to the coronavirus this year have made the e-waste issue worse:

According to Kees Balde, a senior project officer with the sustainable cycles program at the United Nations University and another contributor, people stuck at home are decluttering, and only some workers are collecting and recycling the rubbish due to the lockdowns.

MORE JUNK, NEW CONSUMERS:

The situation in China and India indicates a more significant issue in developing nations with rising demand for refrigerators, air conditioners, and washing machines. The survey stated that "the e-waste management infrastructure is not yet fully developed or, in some cases, is absent" in middle- and low-income countries.

According to Dinesh Raj Bandela, deputy project manager at the Centre for Science and Environment, a New Delhi-based research and advocacy organization, India's focus on e-waste must go beyond collecting, and manufacturers should be encouraged to make consumer items more durable and less harmful. Although India is the only country in South Asia to have drafted e-waste legislation, its collection practices are still crude. The tangle of dirt roads in Seelampur is home to thousands of scrap yards where workers search through salvageable items from the garbage amassed from all over north India.

Outside each store, mountains of outdated monitor screens, desktop computers, damaged landlines, mobile phones, televisions, voltage stabilizers, air conditioners, refrigerators, microwaves, vacuum cleaners, and washing machines. The old electrical cable is rolled or left strewn across the mounds of electronic waste. Any outsider passing through the confined alleys, particularly journalists, is viewed with considerable suspicion by the shop owners and employees. Mohammed Abid, a scrap e-waste dealer available for an interview, disputed that how e-waste was handled in Seelampur violated regulations or created risks.

The stink from an adjacent open sewer filled the air as he remarked, "There are some jobs that cause many problems for the environment, but in this market, no such work is done that damages the environment or increases the pollution - nothing of that sort is done here.

Electronics can also contribute to finding a solution:

E-waste:

Try to get a count of all the electronics we have at home. Multiply that figure by the total number of households in our city, state, or country. Have we ever wondered what happens to all of those gadgets after they become obsolete and are discarded? The amount of unused and abandoned electronic devices is growing along with the global demand for these products. Around 50 million tonnes of e-waste are produced yearly,

more than all commercial aircraft ever built together. By 2050, the quantity of e-waste generated annually is predicted to more than treble if nothing changes.

What transpires to our devices if we throw them out?

Only 20% of all discarded electronics are recycled through formal, controlled routes, while most e-waste in many poor nations is either dumped in landfills or handled informally. Only 35% of documented cases of adequately managed and recycled e-waste come from the EU, which is regarded as a global leader in the field.

Groundwater and soil are contaminated by e-waste at landfills. Because our devices contain a significant quantity of dangerous substances, including mercury, lead, bromine, and arsenic, the informal and unregulated e-waste treatment poses a considerable risk to the health and well-being of workers and communities. For example, prolonged exposure to arsenic in the microchips of numerous devices, including mobile phones, may result in lung cancer, nerve damage, and several skin conditions. Children are especially at risk for lead exposure, which can result in brain and kidney damage and blood issues.

Exporting electronic garbage from industrialized to developing nations has been prohibited by the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and Their Disposal, which has been in force since 1992. In addition, the Basel Convention's parties passed the Ban on Exporting Hazardous Waste to Developing Countries in 1995, which forbids the export of hazardous waste from EU, OECD, and Liechtenstein members to any other nations. 98 nations ratified the ban, which went into effect on December 5, 2019.

Despite this, a sizable volume of outdated technology from developed nations ends there. An estimated 352,474 metric tonnes of electronic garbage are illegally exported from the EU annually to underdeveloped nations, most of which are in Africa (notably Nigeria, Ghana, and Tanzania).

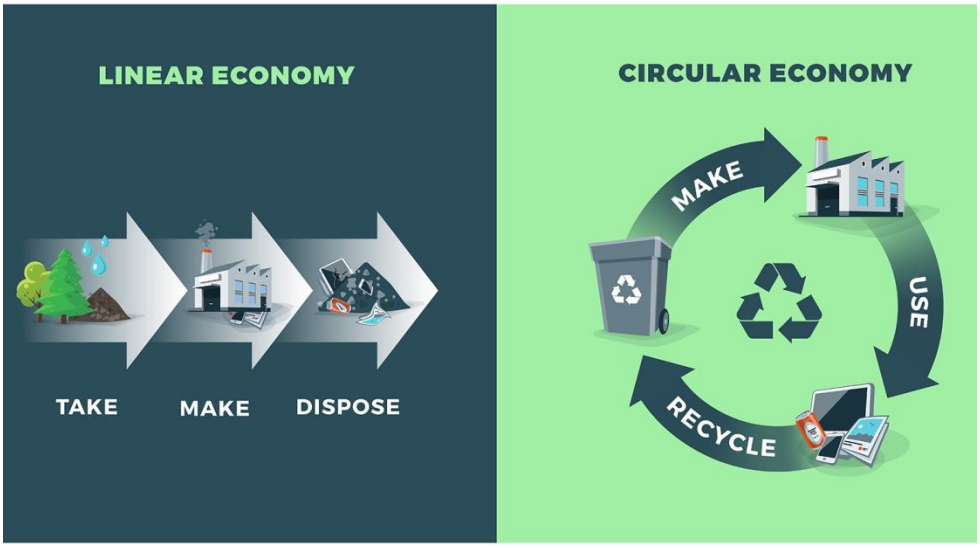
The ban is still pending ratification in several major economies, including the US, Canada, South Korea, and Japan, to mention a few. Even the nations that have accepted the ban have yet to adhere to its rules. According to a two-year investigation that followed exports from 10 European nations, the UK, which has been a party to the ban since 1997, is considered Europe's biggest offender for the export of e-waste that is illegally produced. The global status of e-waste laws and regulations is depicted in the map below. This visualization is based on

information from many websites, including The Global E-waste Monitor, official portals, and numerous online news sources.

Several international organizations, including the International Telecommunications Union (ITU), International Labour Organisation (ILO), UN Environment Programme (UNEP), and others, have stressed the importance of effectively and promptly addressing the global e-waste challenge. The UN has also addressed the growing e-waste problem, frequently warning of a "tsunami of e-waste rolling out over the world."

A "Letter of Intent" was signed in March 2018 by some organizations, including the UN mentioned above agencies, to set up a structure for coordination and collaboration among stakeholders in the fight against e-waste. The statement also served as the foundation for forming the E-waste Coalition, an organization dedicated to e-waste policy lobbying, knowledge sharing, and developing a unified intervention approach at the federal level. The 'Letter of Intent signing was a significant step forward for international e-waste management programs, but the growing threat at the international level still needs to be managed and institutionalized. To that aim, the threat posed by rising e-waste has continued to be eclipsed by other global problems: During the recent UN General Assembly session, no delegation brought up the issue.

Electronics could contribute to the solution and be the root of the issue. Many raw materials—copper, tin, iron, aluminum, fossil fuels, titanium, gold, and silver—that are genuinely recyclable are wasted daily. For the medals for the 2020 Olympic and Paralympic Games in Tokyo, for instance, around 32kg of gold, 3,500kg of silver, and 2,200kg of bronze were retrieved from about 78,985 tonnes of electronics. One method to reuse otherwise-discarded electrical components is illustrated above. In this sense, international organizations and other stakeholders are increasingly discussing e-waste within the context of the 'circular economy' notion instead of the prevalent 'take-make-dispose' economic paradigm.



A circular electronics system is one in which resources are valued and reused in ways that "create decent, sustainable jobs," according to a report titled "A New Circular Vision for Electronics - Time for a Global Reboot" that was released at the WEF in Davos in January 2019 and was created by seven UN entities, the World Economic Forum (WEF), and the World Business Council for Sustainable Development. The economic benefits of adopting the circular economic model in the electronics industry are substantial, given that the value of e-waste is at least $62.5 billion yearly, exceeding the GDP of most nations. In addition to immediate economic benefits, recovering these precious resources could lower the price of electronic items for consumers. Some precious metals, like gold, are more concentrated in e-waste than in the most productive mines.

Additionally, implementing a circular economy can create millions of jobs globally. E-waste management can lead to many worthwhile employment opportunities, which would speed up the implementation of the 2030 Agenda for Sustainable Development, particularly in fair labor conditions and economic growth (SDG 8) and responsible consumption and production (SDG 12). Most people know that obsolete gadgets should not be disposed of in the garbage, but do we know where they go after that? Here are some shocking e-waste statistics to make us reevaluate how we dispose of our old electronics.

A report on the most significant e-waste data for 2022. bringing attention to the concerns about the amount of computer technology we are developing and making some ominous predictions about how serious this problem might become globally.

E-waste data for 2022:

In 2022, the e-waste situation will only worsen, according to United Nations research. E-waste currently makes up about 20% of all waste produced worldwide, and by 2025, this percentage is predicted to reach 30%. The ever increasing demand for new technologies and the aging infrastructure that supports them are to blame for the current e-waste catastrophe. According to the report, by 2025, roughly half of all devices are anticipated to be obsolete.

The United Nations has urged the Member States to take action to stop the e-waste situation from getting worse. The export of used electronics is prohibited, financing for recycling initiatives is increased, and e-waste threat education is improved. In 2022, the e-waste situation will worsen. By then, informal recyclers or landfills will hold more than 60% of the world's electronic garbage. The United States is where 40% of the world's electrical waste is produced. Between 2017 and 2022, the number of e-waste collectors in developing nations is anticipated to increase by more than 140%. By 2022, the number of early deaths linked to e-waste pollution is expected to rise from 300,000 to over 1 million.

An RTI International study predicts that by 2022, the amount of electronic trash produced in Africa and Latin America will increase dramatically. The exponential proliferation of technology throughout time is a factor in this rising trend of e-waste. Because people are becoming more mobile, they are using more technology daily. People are also utilizing more gadgets at once, which increase the amount of defective or outdated electronics that wind up in landfills. E-waste has a concern since it contains toxic substances like lead and arsenic. If these substances are swallowed or leaked from electronic equipment and enter the environment, they may harm human health. Additionally, improper handling of e-waste can result in fires and explosions.

More than enough electronic garbage is generated globally each year to fill a space the size of France. Furthermore, this tempo is not about to slow down. According to the World Health Organisation (WHO), up to 63 million tonnes of electronic trash will be produced yearly by nations worldwide by 2022, an increase of about 30% from 2018.

This unfathomably large volume of e-waste is a catastrophe for our environment and health. Everyone who comes into contact with the harmful materials in our electronics faces significant health hazards. More than 164 million e-waste items will be created in 2022. Through 2030, this figure is anticipated to rise by 37% per year. The explosive proliferation of smartphones and other mobile devices is one of the critical causes of this expanding e-waste issue.

As a result of the rising demand for smartphones and other mobile devices, more e-waste is being produced. 58% of the rubbish produced by humans worldwide in 2018 was e-waste. We need to inform people about the negative consequences of e-waste in order to assist in decreasing the amount that is produced. In addition, we need to think of ways to reuse or recycle these things rather than discard them.

The worldwide e-waste market will reach $30.5 billion by 2022, predicts the e-waste generation research. Additionally, other types of equipment are also building up in landfills. A startling amount of computer hardware, such as motherboard assembly, CRT displays, printers, and scanners, is being discarded at an alarming rate. It's no secret that we live in an era where most consumption is done online. However, many people might need to realize that our reliance on gadgets is harming the environment. It is now more crucial than ever to dispose of devices sustainably.

There are a few things we can take to decrease the adverse effects of our e-waste disposal on the environment. For instance, instead of discarding outdated devices before they are replaced or are no longer functional,

consider reusing them or donating them to a local charity. To have our old gadgets recycled into new products, bring them to a recycling facility. Inform ourselves and others about responsible electronic disposal techniques. To raise awareness of the appalling e-waste numbers for 2022, share this article with our friends and family.

Why does the e-waste epidemic seem to have no end in sight?

People's ignorance of the e-waste situation and how it impacts them is one reason why it seems insurmountable. Many individuals mistakenly believe that e-waste consists only of outdated technology. Nevertheless, that only tells a portion of the tale.

E-waste contributes significantly to pollution. E-waste can contaminate streams, lakes, and oceans with harmful chemicals like metals and plastics. People who attempt to recycle these materials incorrectly risk harming their health.

The good news is that we can take action to address the e-waste issue. Both the production of new e-waste and the amount of e-waste already in existence can be stopped. According to estimates, e-waste pollution could cause half a million deaths in as soon as 12 years if these measures are not taken.

Nations generating the most electronic garbage:

1. Of all the nations in the world, the United States creates the most e-waste.

2. China is the second-largest producer of e-waste, behind only Germany and Japan.

3. Of all the continents, Europe produces the least e-waste.

4. A significant portion of the electronic debris dumped in landfills comes from junk sites.

5. The long-term effects of e-waste on the environment and public health are causing significant worry.

E-waste is a serious issue, and it will only become worse. In this post, we have drawn attention to specific e-waste figures that demonstrate the scope of the issue. These statistics will help us understand how crucial it is to start considering how we may lessen our e-waste footprint so that we can all do our part to address the e-waste epidemic.

Disposal method:

The primary method of e-waste disposal is land-filling. Most of the time, discarded electronic products either burn openly or end up in landfills with other municipal rubbish, releasing harmful and cancer-causing gases into the atmosphere. Regarding the safe processes and practices used, the informal disposal of e-waste in developing and transitioning nations is relatively primitive, leading to low material recovery.

Developed countries manage e-waste differently than developing and transitional nations. Guidelines and education campaigns about the fate of e-waste should be present in developing and transitional nations. Notably, less advanced disposal methods are employed, such as open burning, dumping, and unregulated landfill sites, which pose severe environmental contamination and workplace exposure to toxins created from e-waste. In developing nations like Brazil, China, and India, significant problems with e-waste disposal were analyzed. These problems included the difficulties of implementing/enforcing clean technology standards and existing rules due to a lack of knowledge and capacity building.

In contrast, developed nations have created expensive systems and complex garbage disposal plans that are less dangerous to manage. The lack of data prevents a complete analysis of the problem, nevertheless. It means that e-waste management in developing and transitional nations is constrained by the disparities in the socioeconomic and legal contexts between typical developing and developed country scenarios. While developed countries have strict rules and efficient monitoring, the legislation that governs how to dispose of e-waste in developing countries is primarily scattered and needs more oversight.

AN OVERVIEW OF INTERNATIONAL E-WASTE COLLECTION PROGRAMS WITH A GEOGRAPHICAL FOCUS

Due to its various elements, citizens must sort and segregate e-waste to prevent it from being dumped in landfills and mixed municipal garbage collection programs. It must be stored before moving to the curb or a remote collecting location. Although studies have shown that homes choose a curbside collection as the most convenient method, off-site drop-off is appealing to waste management agencies. It is because curbside collections are considered costly, labor-intensive, and difficult to plan, manage, and maintain.

A different parallel collecting and management plan run by the government, manufacturers, or retailers is needed. Convenience is crucial since source separation requires more work from people regarding material

segregation and drop-off than simple or commingled collection, such as single-stream collection. E-waste is collected in industrialized nations in order to recover some valuable materials and safely get rid of harmful substances like lead, cadmium, mercury, dioxins, and furans that they contain. On the other side, e-waste is primarily gathered in underdeveloped nations in order to recover a few valuable metals. It seems sensible that collecting electronic garbage is a business endeavor. Numerous engineering materials can be recycled from e-waste using existing and developing technology.

Asian continent:

A planned infrastructure is being developed in Malaysia for the collection of WEEE in its entirety from homes, businesses, and institutions. For the first time in Penang state, the Department of Environment (DoE) and the Japanese International Cooperation (JICA) are working to create an e-waste collecting model for household items. After the model's test drive, which could take place within the next few years, it is anticipated that this model will be utilized to perform a cross-country drive. This strategy, however, is constrained and can only guarantee the collection of a tiny percentage of e-waste. Since an optimization analysis has not been planned, there is no engineering examination of material qualities, remanufacturing potential, or economic benefits. Furthermore, this model does not include a reverse logistic system. The DoE-licensed contractors, retailer collections, environmental working groups, voluntary collection organizations, social organizations, unofficial scrap collectors, street buyers, scavengers, traditional hawkers (Surat khabar lama), and manufacturer initiatives like Panasonic Malaysia ECOMOTO Take back, Nokia Malaysia, Dell Malaysia HP, and Pikom (National ICT) are just a few of the e-waste collection activities in Malaysia.

The informal sector collects most waste materials and components in other Asian nations. In Asia, "scavenging," or the informal sector, is the primary method of collecting e-waste. Using improper practices severely harms the environment and workers' health. For instance, this informal stream of e-waste collection needs to be regulated in China, Taiwan, Thailand, the Philippines, Indonesia, and other nearby countries, and most of the e-waste generated through this informal stream ends up in landfills. Furthermore, there are few established markets for completed items made from recycling, and collecting systems and practices could be laxer in the area. To encourage customers to return their EOL e-products to the collection centers, incentives must be provided. Studies clearly show that consumers in India and China seek financial rewards for getting rid of their e-waste. In the event of a take-back regime, Chinese residents prefer the pay-in-advance system over the deposit-refund method preferred by Indian inhabitants. India has a well-organized and successful door-to-door collection network. To encourage practical and ecologically friendly recovery of native and imported metals, China has built specific recovery industrial parks in Tianjin, Taicang, Ningbo, Linyi,

Liaozhong, Taizhou, and Zhangzhou. The so-called informal individual collectors (peddlers) still dominate China's gathering of discarded domestic electrical and electronic equipment. By paying marginal fees to e-waste owners, they offer a door-to-door service before selling the items to e-waste merchants.

Considering the European Union:

In Europe, consumers collect e-waste through municipal collection, retailer collection, social organization collection, and the resale market. Local government entities (counties or municipalities) oversee the so-called municipal collection. It is noted that some towns collect the WEEE directly, while others contract with third parties to collect it on their behalf, and still, others collect it themselves. Public waste management organizations oversee municipal collection initiatives, which employ drop-off locations and doorstep collection. The merchants themselves or their logistical partners who deliver new appliances to customers handle retailer collection. To give the social organizations material input and financial gain, the social organization collecting is carried out in collaboration with several participants in the reverse supply chain. The reuse market prolongs the usage phase of appliances, postponing the final disposal of the device into the municipal, retail, or social collection by the ultimate owner/user. Germany has created a curbside collection program and is already successfully recycling and managing e-waste. E-waste is safely disposed of or processed through the standard collection channels in the EU, which begin with dismantling and continue through pre-processing and end-processing.

Canada's and the US's situation:

US and Canadian provinces are adopting EPR and product stewardship (PS) programs for WEEE more frequently. For instance, the WEEE management program in the US state of Maine is built on a PS plan, and shops are actively involved. In terms of e-waste issues, three American-based non-governmental organizations (NGOs) are particularly active. A linked network of US environmental advocacy NGOs includes the Basel Action Network (BAN), Silicon Valley Toxic Coalition (SVTC), and Electronics Take-Back Coalition (ETBC). Promoting national-level approaches to hazardous waste management is the three organizations' shared goal. E-Stewards, a system for evaluating and certifying recyclers and take-back programs, is a recent project that aims to let conscientious consumers know which ones adhere to high standards. One of the nations creating systems based on these ideas and EPR is Canada. Additionally, Canada has highly advanced collection methods. Apple, Sony, Sharp, Mitsubishi, Samsung, HP, Dell, LG, Lenovo, Panasonic, and Toshiba all provide free take-back programs for their goods in the US.

Brazil and Japan:

Japan has a door-to-collection system to keep municipal collection programs and e-waste separate. The producers must then pay the recycling cost after the merchants and, in some situations, the municipality has delivered the collected units to the producers' designated collection locations. Producers are required to gather e-waste from the approved collection locations and meet the recovery goals established by the law. In Brazil, three methods can be used to dispose of and recycle "e-scrap": collection by social organizations, manufacturer collection, and merchant collection.

In general, developing nations' trash collection infrastructure is characterized by a high level of informality. As a result, even once a regulated e-waste management system is implemented, there will still be some informality. It has been determined via evaluation of the management of e-waste in developing and transitional countries that informal recyclers will continue to gather significant portions of e-waste with the economic value from individual households. Similarly, the study revealed that the main obstacle is to direct the informal sector towards mechanisms that could function in a future regulated environment. Thus, focusing more on incentivizing private individuals and businesses to dispose of potentially hazardous WEEE into official collection systems would gradually increase the efficiency of e-waste management systems. As a result, a financial strategy could offer compensation for the return of outdated equipment to improve the system's viability.

Best practices for WEEE management are currently being used in developed and developing nations:

It is a complex undertaking to properly and efficiently manage the growing amount of e-waste in terms of cost and environmental impact. Therefore, adopting best practices and implementing mitigation measures are crucial in managing e-waste goods, especially at the EOL. Therefore, emerging and developed nations have devised various disposal methods, procedures, and regulatory frameworks to appropriately manage such material in response to the expanding quantities of e-waste and its potential effects. It is known that the following factors should be taken into account when creating an efficient e-waste management system:

Special logistical requirements are needed to collect e-waste from the point of generation and delivery to disposal sites and treatment facilities. E-waste disposal calls for specific handling because it contains numerous hazardous compounds exceedingly damaging to human health and the environment. Gold, silver, and copper are abundant in e-waste and can be recovered, repurposed, or used again in the production cycle.

The way that industrialized nations and emerging economies manage e-waste differs significantly. Many developed nations have recognized the value of creating and enforcing regulatory frameworks (laws and regulations) to address the constantly growing volume of WEEE and have developed several laws and regulations to limit the detrimental effects of WEEE on environmental and occupational health.

Best practices for WEEE management currently in use in developed nations:

The EU setting:

The first nation in the world to create and operate a systematic, well-organized system for the collection, transportation, recycling/treatment, and disposal of electronic waste is Switzerland. In order to manage e-waste, the EPR principle is employed as a framework. Manufacturers, makers, and exporters of goods are held accountable by the EPR for the ethical treatment, recycling, and disposal of e-waste. E-waste management is the responsibility of two-based Producer Responsibility Organisations (PROs). The PROs in the Swiss system are made up of the Swiss Association for Information Communication and Organisational Technology (SWICO) and Stiftung Entsorgung Schweiz (SENS. According to the European WEEE directive, the two PROs manage and run the system on behalf of their member producers, who create various types of WEEE. Consumers of EEEs in the Swiss system must pay ARF when purchasing new ones to support system operations like collection, transport, and recycling/disposal. The ARF ensures that the system has the necessary funds since the fees are collected in advance and mandates that the end user pay the recycling fee, which is equal to the difference between the total cost of the system and the total recovered value from the e-waste. According to a study of the Swiss system, consumers who want to get rid of their electronic trash are allowed to drop off old or obsolete gadgets at any retailer or one of 500 authorized collection locations, regardless of the brand or year of manufacture.

The ARF stops since consumers are ready to pay small sums of money for new devices rather than those that would eventually need to be disposed of due to EOL; they prevent the unlawful disposal of e-waste. Multiple levels of independent controls on material and money flow at each stage have been developed to ensure the

smooth operation of the Swiss system. These controls prevent free-riding and theft and guarantee that recyclers uphold quality and environmental standards. It stops e-waste from being illegally imported into and exported from Switzerland. As a result, Switzerland has signed the Basel Convention Ban Amendment and does not authorize the export of e-waste to non-OECD nations.

Sweden implemented its WEEE management rule in July 2001 to ensure the proper handling of WEEE. For instance, the "old-for-new or new-for-old rule" allows customers to return old products to stores when they purchase a similar new product. Additionally, institutional and business customers are responsible for paying the costs of handling WEEE, whereas household consumers can dispose of their WEEE at municipal collection locations. Municipalities are, therefore, in charge of running these WEEE collection stations for residential users, while manufacturers pay for WEEE collection and treatment expenses. Under the old-for-new rule, a store is required to accept WEEE from customers.

Japan:

In order to launch its own WEEE recycling system that incorporates EPR and create a sound material-cycle society that supports the 3R principle, Japan created a new legal framework. Such a rule was required because effective e-waste treatment would allow for proper resource recovery and lessen reliance on landfills. The fact that the Japanese EPR law is primarily founded on the shared responsibility principle, in which the responsibilities of various stakeholders are expressly shared, makes it distinctive. For instance, under the Home Appliance Recycling Law (HARL), producers are required to set up pretreatment facilities and collection networks, and consumers are responsible for funding recycling and transportation by paying recycling fees to the retailer at the point of disposal. The law covers Four essential e-waste goods, as mentioned earlier: air conditioners, televisions, washing machines, and refrigerators.

Bulk and business customers, on the other hand, can either return to the merchant after paying the necessary recycling fees or engage in the treatment of e-waste at their own expense. Personal computers (PCs) from the corporate and family sectors were both covered by the EPR law when it went into force in April 2001 and October 2003, respectively. However, recycling expenses for computers are paid at the point of sale rather than at the point of disposal, as they are for products covered by HARL. In order to address the needs of small electronic and electrical home appliances, including mobile phones, gaming consoles, small personal computers, etc., a new law known as the Small-sized Home Appliance Law was passed in April 2013. The new law exempts consumers from recycling fees and covers around 100 goods. According to this new regulation,

the relevant municipality is responsible for setting up collection centers from which collected waste will be transported to approved recycling businesses.

Additionally, it is required that each municipality create its collection sites and list the things that will be collected. Retailers or thrift stores will accept back-home appliances. The recycling system, however, needs help with inflexible recycling prices, unlawful dumping, illegal transfer by retailers, and the scarcity of target appliances.

Singapore:

Retailers in Singapore have created commercial take-back programs for their goods. Used mobile phone costs are decided by sellers based on quality. It is known that mobile phones are leased for a lower price than the sales price for the duration of the contract (for example, two years). Because of this, used mobile phones are returned in about 95% of cases. Singapore has a thriving secondhand mobile phone market, with many retail stores selling used phones. It demonstrates how efficiently Singaporean retailers are collecting EOL e-products.

Application of the most advanced WEEE management techniques in developing nations

Korea, South:

The Waste Recycling Act, also known as the Act on the Promotion of Conservation and Recycling of Resources, was enacted in Korea and went into effect in 1992. Together with air conditioners and refrigerators, the Act also regulated two household appliances: televisions and washing machines. Other statutory instruments include the 1992 Waste Deposit-Refund System for specific categories of home appliances, packaging materials (such as glass, plastics, and cans), and other items (such as lubricating oil, batteries, tires, and fluorescent lamps); the Waste Recycling Act was modified to encourage the efficient material collection and recycling and to promulgate EPR regulations for products covered by the Waste Deposit-Refund System for personal use. The EPR system was implemented in 2003 to encourage recycling.

China and India:

China and India have introduced programs that are comparable to the EPR. With EPR, manufacturers are more accountable for controlling how their products affect the environment at every stage of their lifecycle,

especially after it. Manufacturers of EPR items must collect and recycle a set quantity depending on a predetermined portion of their annual production output. The Ministry of Environment and Forests (MoEF) in India has released more pertinent and significant regulations in the last ten years, the most significant of which is letter no. 23-23/2007-HSDM dated March 12, 2008, the environmentally sound e-waste management guidelines. This letter aims to guide the identification of different e-waste sources and lay out procedures for environmentally sound handling of e-waste. The MoEF released a draft of the E-waste (Management and Handling) Rules, 2010, on May 14. The regulations explicitly state that the producer must collect e-waste properly through a suitable take-back mechanism following the European EPR Regulation. However, this rule must cover the precise methods used to handle and treat WEEE. Although they attempt to address the hazardous and non-hazardous compounds contained in e-waste, the Hazardous and Waste Management Rules, 2008, and Municipal Solid Waste Management Rules, 2004, do not specifically define the duties of the various stakeholders in e-waste management. The critical issue in India is the administrative time it takes to implement these policies. According to EU guidelines, the Chinese government has constructed infrastructure and introduced legislation regarding WEEE and removing hazardous substances (RoHS).

Brazil:

The Brazilian government has created broad environmental regulations that apply to the treatment of e-waste, such as Decree 7.404 of December 23, 2010, Act 12.305 of August 2, 2010, which established a National Policy on Solid Waste, and a "reverse logistics" obligation for e-waste. The National Policy on Solid Waste (CNPSW) Committee was created to aid in the organization and execution of this policy through coordinating government institutions. Then, a thematic group (TG) comprised of various stakeholders—including representatives from NGOs, businesses, municipalities, and government agencies—was established. Only Sao Paulo passed Law 13576, an e-waste law based on EPR, on July 6, 2009.

Africa:

With assistance from the Global Knowledge Partnerships in the e-Waste Recycling program, which was developed by the Swiss State Secretariat for Economic Affairs (SECO) and implemented by the Federal Laboratories for Materials Testing and Research (EMPA), several projects were successfully launched as early as 2004 in three South African provinces (KwaZulu-Natal et al.). It is known that several (international) IT companies have demonstrated a growing willingness to launch and support national initiatives to address the problem of e-waste. The e-Waste Association of South Africa (eWASA) was founded in 2008 to deal with the country's sustainable and environmentally sound e-waste management system. These attempts, however, need

more effective enforcement and monitoring. Therefore, despite these measures, inappropriate e-waste management persists.

Despite the lack of laws governing the extraordinary collection and disposal of e-waste in underdeveloped nations, several nations offer distinct programs for particular categories of e-waste. Only some manufacturers from developing nations have established unique take-back programs for particular products as part of their corporate social responsibility and green image due to increased public awareness, and government focus on the issues arising from e-waste. The management plans are, in brief, divided into the following categories:

There are take-back regulations in the form of disposal (or recovery) costs that are assessed at the time of purchase or at the time of disposal (also known as advance recycling or advance disposal fees). The Japanese model, for instance, supports both strategies: upfront payments for computers and fees at the time of disposal for household equipment. On the other hand, advanced recycling fees for all items are preferred by the Californian and Taiwanese models, which are often used to finance the state-controlled recycling infrastructure. The benefit of advanced disposal or recovery costs is that they are apparent to all stakeholders, which improves downstream planning. Additionally, costs levied at the point of disposal could result in an uninterested disposer who would probably be inclined to unlawfully dump the used goods or keep them in storage indefinitely.

Regulations have been implemented recently to eliminate dangerous things or get the most out of recyclable materials. Others want to boost e-waste collection and recycling rates through various collection programs, encourage manufacturers to create more environmentally friendly products, and make it mandatory for manufacturers to recycle their goods. The Best-of-2-Worlds (Bo2W) philosophy has been introduced, which aims to integrate the "best" end-processing strategies to treat hazardous and complex fractions in international state-of-the-art end-processing facilities with the "best" pre-processing facilities to manually dismantle e-waste in developing and transition countries. E-waste recycling can lessen environmental damage by using eco-friendly product designs as an alternative. Design for Environment (DfE), a new approach to reducing environmental pollution, is currently gaining much attention throughout the globe. The DfE principle reduces the environmental effect of products before they are released onto the market. According to DfE, easy disassembly to promote household appliance recycling, recycling recyclable materials, energy conservation, and decreasing hazardous compounds, including Pb, Hg, Cd, and hexavalent Cr, are all goals. We can anticipate a significant reduction in the environmental harm caused by recycling e-waste scrap if DfE, in particular, spreads more widely.

An overview of the illegal electronic waste trade and the associated illegal waste disposal methods:

The black market for e-waste:

Large amounts of electronic garbage have recently been dumped all over the world. Even though many nations have established e-waste legislation, there are still issues with e-waste import and export. For instance, recycling operations have established solid environmental and ethical norms in industrialized nations like the US, Japan, and the EU, prompting illegal WEEE shipment to developed and transitional nations. Developing and transitional nations need cleaner technology, waste minimization strategies, and environmentally sound management methods. As a result, less thought is given to environmental preservation, public health, and safety while handling, recycling, or reusing the objects.

Several nations have ratified the Basel Convention on the Transboundary Movement of Hazardous Waste. The obligation of the importing country's government and the pertinent criteria for governments exporting hazardous waste are stated. However, the convention's standards do not cover these goods because no management mechanisms exist for used e-products and e-scraps. The Basel Convention needs to resolve the new environmental issues brought on by the recycling of e-waste. Through covert operations, legal snares, and nations that have not joined the convention, the export of used electronic gadgets from developed nations to developing and transitional nations has persisted in recent years. For instance, every year, Japan exports to the Philippines roughly 400,000 of the nearly 2 million used televisions that are produced there. In Manila, however, incorrect recycling and final treatment procedures have been noticed, including the open burning of wires and the improper crushing of CRT tubes. Basel Convention amendments are required to stop the shipment of hazardous materials from industrialized nations to developing and transitional nations for any reason (even for recycling).

The legal systems in China, Vietnam, and Cambodia have been explicitly developed to address the importation of hazardous wastes and used goods. For instance, in 1996, Cambodia outlawed the import of computers due to worries that viruses would get into its local computer systems. However, there are no laws governing the scrap of electronic trash.

China altogether outlawed the importation of used EEE in the year 2000. The importing of printed circuit boards was likewise forbidden. Vietnam enacted a similar prohibition on importing used EEE, including computers and household appliances in 2001. Vietnam passed legislation between 2004 and 2006 to enact

stricter restrictions on the importation of used EEE (with the issuance of Governmental Decree No. 12/2006/ND-CP) and the re-exportation of scrap e-waste by the Minister for Trade (Decision No. 5678/VPCP). In addition to regulations prohibiting the importing of used EEE, pertinent bans on importing e-waste scrap for any purpose and dismantling of e-waste scrap were also passed in July 2005. Although China and Vietnam have enacted import restrictions on used EEE and printed circuit boards, research studies have shown that substantial amounts of these materials still enter these two countries due to the demand for used electronic products and used parts. These nations also need to implement policies and monitoring procedures better. For instance, China permits importing used EEEs as long as they are constructed and then exported again. An estimated 57,700 tonnes of e-waste are illegally imported each year, of which 8,470 are exported again. Mandatory removal also causes inappropriate recycling practices to spread to other locations. Given this context, it is evident that a sizable percentage of electronic waste debris, including printed circuit boards, has been and is being recycled or trafficked into China, Vietnam, and Cambodia.

Illegal electrical and electronic waste exports to non-EU nations are still being discovered at EU borders. Because recycling businesses, scrap dealers, brokers, and so-called reuse enterprises profit from low dumping prices and environmental standards, previous research investigations indicated that considerable sections of materials are still illegally transported outside of EU member states. In Japan, illegal dumping is still a significant issue, and some e-waste is exported outside as salvageable components. The top recipients of e-waste from developed nations are China, Peru, Ghana, Nigeria, India, and Pakistan. Singapore, Malaysia, Vietnam, the Philippines, and Indonesia are other significant nations that receive e-waste [5, 21, 74]. Every month, 500 containers containing electrical and electronic equipment arrive in Nigeria. According to some analysts, 400,000 secondhand computers are imported each month. Only about 50% of these are operational. The equipment is made up of roughly 45% each from Europe and the USA and 10% from Asia. Ghana, where laptops, televisions, and monitors were the most frequently imported items, too experienced this issue. According to the currently available data, approximately 300 containers of UEEE/WEEE arrive in Ghana each month via the ports of Tema. Germany, the Netherlands, and the United Kingdom export the most equipment to the EU. According to research, between 75 and 80 percent of imported UEEE/WEEE cannot be recycled.

An overview of the unethical waste disposal methods connected to the e-waste fraction:

Since proper e-waste recycling using effective technologies and facilities is uncommon in developing and transitional nations, e-waste is managed using various low-end management options, including disposal in open dumps, backyard recycling, and disposal into the environment, including surface water, conventional landfills, etc. The bulk of useless parts is carelessly discarded, which pollutes the environment and water

supplies. Official e-waste recycling facilities must still be set up in developing and transitional nations. There are industrial zones in certain developing nations, such as South Africa, Indonesia, India, etc., where recycling facilities and plants have been constructed. However, recycling computers, televisions, etc., in the garden is a widespread practice. For instance, informal workers frequently recover valuable elements from e-waste, including gold, from an integrated circuit (IC) socket or chipset. They burn ICs and mix the resulting residue with various chemicals (such as nitric acid (HNO3), selenium, etc.) to recover gold while using just their bare hands and without any personal protective gear (PPP) for safety and health protection. This technique produces wastewater that contains heavy metals (such as Cu, Cr, Co, Pb, nickel (Ni), Sn, and zinc (Zn)) that are over World Health Organisation (WHO) threshold limits for wastewater standards.

E-waste's effects:

The main issue in non-OECD nations like India, China, etc., is the unregulated recycling of WEEE, known as "backyard recycling" by the so-called informal sector. The most urgent environmental problem related to e-waste is informal recycling. Relevant case studies on informal e-waste recycling conducted by highlighted how using antiquated equipment and techniques to recover valuable materials and components from WEEE can pollute the land, air, and water. These techniques include open burning of plastic waste, exposure to toxic solders, and acid baths. One of the most well-known instances of a center for incorrect PCB recycling is Guiyu in the Chinese province of Guangdong. It has been reported that improper e-waste disposal techniques have health impacts. These include toxic exposure at higher than normal levels in the air, soil, water, and human tissue. It is because there are no reusability standards or legally binding guidelines intended to provide a shared understanding of handling practices for e-waste in developing and transitional nations. In addition to Guiyu, Guangdong Province has several smaller printed circuit board recycling hubs, including those in Guangzhou, Dongguan, Foshan, Shunde, Zhongshan, and Shenzhen.

Recycling e-waste scrap pollutes the air, soil, and water in addition to water. A recent study on e-waste recycling noted that incomplete combustion of e-waste led to rising levels of persistent organic pollutants (POPs) in the Guiyu air, including polychlorinated dibenzo-p-dioxins dibenzofurans (PCDD/Fs), PBDEs, polycyclic aromatic hydrocarbons (PAHs), and PCBs. POP and heavy metal concentrations that were higher together created more conducive circumstances for severe soil pollution. Environmental damage from recycling printed circuit boards has been seen in some parts of Vietnam. Prolonged exposure to these hazardous compounds may have unfavorable health effects, including cancer, lousy birth outcomes, long-term and chronic brain impairment, and end-organ diseases of the thyroid, lungs, liver, and kidneys. Significant environmental effects and hazards to employees caused by simple disposal methods have been studied in

Indian cities like Bangalore, highlighting the rising concentration of elements like Cu, Zn, In, Sn, Pb, and bismuth (Bi) in the soil around shady recycling businesses. As a result, rising levels of Cu, Sb, Bi, Cd, and Ag were discovered in the worker's hair samples. In contrast to the EU and Japan, which have well-developed initiatives at all levels aimed at changing consumer behavior, e-waste management in developing countries is made worse by the lack of enforcement or implementation of the existing regulatory framework, a lack of awareness and sensitization, or a low level of enforcement. In order to reduce environmental contamination and threats to human health, developing countries must adopt effective strategies to promote the reusing, refurbishing, or recycling of e-waste in specialized facilities.

Conclusions:

For governments in many nations, managing e-waste is a significant difficulty. Its toxic components could harm the environment and human health if improperly managed. Restrictive regulations have been put in place in developed nations to control e-waste. However, a well-established business sector that uses damaging techniques to recover valuable elements from e-waste is present in the economy of emerging and transitional nations. These techniques harm both people and the environment. Targeting the most environmentally harmful practices while reforming these informal sectors in emerging and transitional nations may be advisable. In order to collect, effectively manage, and dispose of e-waste in a way that avoids open burning and conventional landfills, there is an urgent need to connect the informal sector with the formal sector. It will reduce the adverse effects on public health and the environment. The appropriate authorities must establish E-waste handling and treatment procedures in developing and transitional nations. Promoting environmentally friendly e-waste management programs requires expanding informational campaigns, capacity building, and awareness. Developing information management systems for defining what contributes to e-waste, generation, and management requires significant attention in developing and transitional economies. Increased efforts are urgently needed to improve present procedures, such as collection plans and management techniques, to decrease the illegal trade in e-waste and safeguard the environment and the general public's health. Since it will aid in prevention, reducing the number of hazardous compounds in e-products will also benefit handling the specific e-waste streams.

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