

State of the Planet

GENERAL EARTH INSTITUTE

What Can We Do About the Growing E-waste Problem?

BY RENEE CHO | AUGUST 27, 2018



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E-waste in Alabama. Photo: Curtis Palmer

When China banned 24 kinds of solid waste last September, countries such as the U.S., the United Kingdom, Australia, and Japan realized they had a big problem. Until last year, China accepted 70 percent of the world's electronic waste—discarded computers, cell phones,

printers, televisions, microwaves, smoke alarms, and other electronic equipment and parts. After China stopped accepting this e-waste out of concern for its environment, Europe and North America began shipping more of it to Southeast Asia—but now Vietnam and Thailand, whose ports have been overwhelmed, are curbing imported e-waste as well.

In 2016, the world's population discarded 49 million tons of e-waste (equivalent to about 4,500 Eiffel Towers). It's estimated that by 2021, that number will grow to more than 57 million tons.

Why the upsurge in e-waste?

Technology is becoming more and more integrated into every aspect of our lives. Semiconductors and sensors are being added to products that never before had them, creating wearable monitors, smart homes, TVs that can stream programming from the internet, and much more.

Meanwhile, the life span of devices is getting shorter—many products will be thrown away once their batteries die, to be replaced with new devices. Companies intentionally plan the obsolescence of their goods by updating the design or software and discontinuing support for older models, so that now it is usually cheaper and easier to buy a new product than to repair an old one. Meanwhile, the companies continue to profit from steady sales.



Charging cell phones in Uganda. Photo: Ken Banks

And because prices are dropping, electronic devices are in demand around the world as a growing middle class goes digital. Globally, half of all households now have internet access, and 7.7 billion people have cell phones.

What's in e-waste?

Electronic devices are made of a complex mix of materials that include gold, silver, copper, platinum, palladium, lithium, cobalt and other valuable elements. The U.S. Environmental Protection Agency (EPA) says, "One metric ton of circuit boards can contain 40 to 800 times the

amount of gold and 30 to 40 times the amount of copper mined from one metric ton of ore in the United States." These precious materials can be reclaimed through recycling.

But electronic devices also comprise toxic heavy metals like lead, mercury, cadmium and beryllium, polluting PVC plastic, and hazardous chemicals, such as brominated flame retardants, which can harm human health and the environment.

In 2016, the estimated value of recoverable materials in global e-waste was \$64.6 billion, but only 20 percent of it was properly recycled to enable recovery of the valuable materials. Much of the rest is dumped in landfills where toxic chemicals can leach from the e-waste and end up contaminating the water supply.

As more people buy electronic equipment, manufacturers are beginning to face shortages of the raw materials needed to make their products, so reclaiming and reusing the materials from discarded products and waste—a process called urban mining—makes economic and environmental sense. A recent study in China found that mining copper, gold and aluminum from ore costs 13 times more than recovering the metals through the urban mining of e-waste.

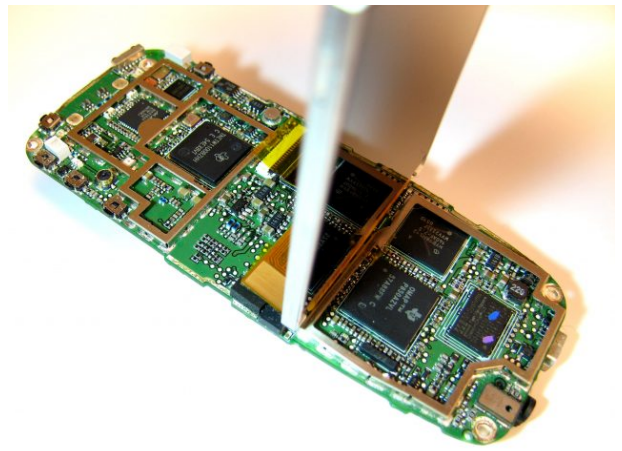
The state of e-waste recycling

Recycling e-waste is practiced both formally and informally.

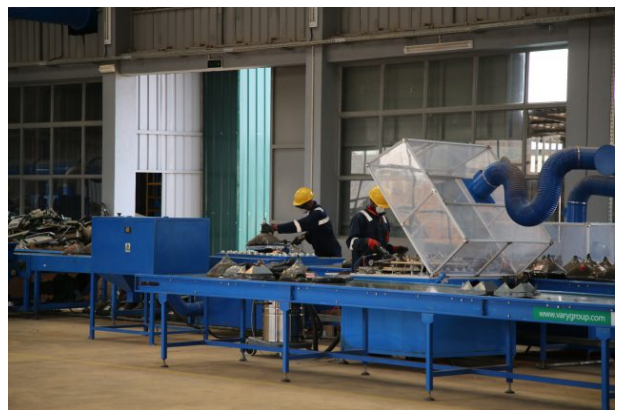
Proper or formal e-waste recycling usually involves disassembling the electronics, separating and categorizing the contents by material and cleaning them.

Items are then shredded mechanically for further sorting with advanced separation technologies. Companies must adhere to health and safety rules and use pollution-control technologies that reduce the health and environmental hazards of handling e-waste. All this makes formal recycling expensive. As a result, many companies and countries illegally export their e-waste to developing countries where recycling is cheap.

The U.S., the second largest producer of e-waste after China, produced 10 million tons of e-waste in 2012, over 64 pounds per person. In 2012 (EPA data for more recent years are not yet available), only 29 percent of this was recycled—the rest is usually landfilled, incinerated or stuck in a closet. A study done by the watchdog group Basel Action Network using trackers, however, found that 40 percent of the e-waste supposedly recycled in the U.S. was actually exported. Most of it ended up in developing countries—usually in Asia—where informal recycling is typically unlicensed and unregulated.



Inside a phone. Photo: Andrew Magill



Formal recycling in Rwanda. Photo: Rwanda Green Fund

At these informal recycling workshops, men, women and children recover valuable materials by burning devices to melt away non-valuable materials, using mercury and acids to recover gold, and dismantling devices by hand to reclaim other materials of value.



Collecting wires which will later be burned in Guiyu, China. Photo: [baselactionnetwork](#)

Usually they do not wear protective equipment and lack any awareness that they are handling dangerous materials. Research has found that inhaling toxic chemicals and direct contact with hazardous e-waste materials (even in some formal e-waste recycling settings) result in increases in spontaneous abortions, stillbirths, premature births, reduced birth weights, mutations, congenital malformations, abnormal thyroid function, increased lead levels in blood, decreased lung function, and neurobehavioral disturbances. Moreover, e-waste toxins contaminate the air, soil and groundwater.

In the face of these health and environmental hazards, however, many people in developing countries earn a living by dismantling, refurbishing, repairing and reselling used electronic devices. Guiyu, China is often considered the e-waste capital of the world, with 75 percent of

households involved in the recycling business. Informal recycling is also practiced in India, Nigeria, Ghana and the Philippines.

In addition to its health hazards, informal recycling can pose security risks, because while formal recyclers in the U.S. usually require wiping devices clean of data, informal recycling does not.



Agbogbloshie, Ghana. Photo: [marlenanapoli](#)

Criminals search e-waste for credit card numbers and other financial information. For example, government contracts and lucrative agreements with the U.S. Defense Intelligence Agency, the Transportation Security Administration and Homeland Security have been found on hard drives in Agbogbloshie, an e-waste center in Ghana.

Wealthy countries send about 23 percent of their e-waste to developing countries each year. This is ongoing despite the fact that the European Union and 186 states have ratified the [Basel Convention](#), which works to minimize the transfer of hazardous

waste from developed countries to developing countries. The U.S, the only developed country that has not ratified the Basel Convention, has agreements that allow it to ship hazardous waste to developing countries.

What U.S. laws govern e-waste?

There is no federal law in the U.S. that mandates the recycling of e-waste or forbids e-waste from being exported to developing countries. Twenty-eight states and the District of Columbia have their own electronic recycling laws, which vary in approach. Some states subcontract with companies to operate a statewide collection system; others require manufacturers to meet minimum recycling targets based on their sales.

The problem with a patchwork of laws is that no one state has enough market share to compel manufacturers to design greener or more durable products. By contrast, the European Union's Restriction of Hazardous Substances Directive represents the entire EU market and thus has the clout to set higher standards for all electronic products sold in the EU. Its laws requiring manufacturers to help pay for recycling have resulted in an e-waste recycling rate of 35 percent, higher than that of the U.S.

A federal law in the U.S. could help develop a more robust e-waste recycling infrastructure through setting targets and establishing financing schemes for collection systems and recycling plants. It could also offer a tax break or rebate to companies that process their used devices,

and help prevent the export of e-waste to developing countries. However, a federal law is not likely to happen under this administration.

A problem requiring multiple solutions

With the flood of e-waste growing around the world, recycling alone will not be enough. Here are some other ideas and solutions that are being researched, considered or practiced around the world. Hopefully, they will inspire more adoption of best practices.

Designing better products

In order to reduce e-waste, manufacturers need to design electronics that are safer, and more durable, repairable and recyclable. Most importantly, this means using less toxic materials. Chemical engineers at Stanford University are **developing the first fully biodegradable electronic circuit** using natural dyes that dissolve in acid with a pH 100 times weaker than vinegar. One group of scientists is **pulverizing** e-waste into nanodust by cooling the various materials, then grinding them up into homogenous powders that are “easy to reuse.” Canada-based Ronin8 has **developed a technology** that uses minimal water and energy as it separates metals from non-metals through sonic vibrations in recycled water.

Today, it’s not a priority to design goods that can be reused or remanufactured, though for a few years, companies experimented with modular phones that enabled consumers to upgrade parts of their phones instead of having to entirely replace them. Google, LG and Motorola all released modular models, but they ultimately failed because they were clumsier and more costly, and because consumers expected their devices to come with every feature as standard. Perhaps as consumers become more aware of the e-waste problem, companies will be able to design a modular phone with more market appeal.



Google's modular Ara. Photo: MaurizioPesce

The right to repair

In addition to recycling, it's also important to be able to repair and reuse the devices we have. But even if you know how to and want to repair your electronic device, you might be stymied because your product's software is subject to copyright. The copyright often forbids consumers by law to tinker with or reverse-engineer the device or use an unauthorized repairer. [Ifixit.org](https://www.ifixit.com/) demands the right to repair devices and teaches people how to do it.

Extended Producer Responsibility

Extended producer responsibility requires companies that make products to be responsible for the management and disposal of them at the end of their lives. The idea is to turn waste materials into a resource for producing new products. [The New York State Electronic Equipment Recycling and Reuse Act](#) requires manufacturers to provide consumers with free and convenient e-waste recycling.

Hong Kong, a prime dumping ground for U.S. e-waste and a huge producer of e-waste itself, deals with 77,000 tons of e-waste yearly (80 percent of which is sent to Africa and Southeast Asia for recycling). It has just instituted a producer responsibility system that will require suppliers and sellers of electronic products to pay for the free removal, collection, handling and proper disposal of items.

More convenient recycling

[EcoATM](#) provides a convenient and safe way to recycle and sell old cell phones, MP3 players and tablets. Consumers can bring their devices to one of 2,700 kiosks in the U.S. The EcoATM will evaluate it based on the model and condition, and pay you right there. The items are then either reused or responsibly recycled.



An EcoATM in the Valdosta Mall, GA.

Photo: Michael Rivera

China's largest internet company, Baidu, and the United Nations Development Programme developed a smartphone app called [Baidu Recycle](#). Chinese users can indicate the item they want to recycle, enter its size, the date it's to be picked up along with their name and address, then submit a photo of it. Within 24 hours, an accredited recycler comes to pick it up. In two months, 11,000 devices were recycled.

Better recycling

Nickolas Themelis, professor emeritus of earth and environmental engineering and director of the Earth Engineering Center at Columbia University, said that the best and only economical large-scale recycling being done in North America today uses a copper smelter in Canada. He explained that when e-waste is fed into the copper smelter, precious metals like silver, gold, platinum, palladium, selenium, and others dissolve in molten copper, which acts like a solvent at high temperatures. The impure copper (because it comprises other metals) that results is then sent to a refinery where pure copper is separated out and the other valuable metals can be collected. This integrated smelting process combined with refining, though it recovers only metals that dissolve in copper, is a relatively inexpensive method of reclaiming e-waste metals. The [smelter](#), in Rouyn-Noranda, Quebec, receives about 50,000 tons of e-waste each year. "The

model of Noranda with a small [e-waste] collection company in the U.S. and a larger one in Canada and a big smelter, could be done in other countries," said Themelis. "It could be done in China which already has copper smelters, as well as in America."

To reduce health and environmental hazards while maintaining the informal recycling system that supports so many people, India and China are looking at ways to integrate the informal and formal recycling systems. One strategy would give informal recyclers financial incentives to divert e-waste to formal collection or recycling centers. For example, they could be paid more to deliver cathode ray tube screens to a formal collection center than they would get for dismantling it by hand themselves.

The goal of a circular economy

A circular economy is one that aims to keep products and all their materials in circulation at their highest value at all times or for as long as possible. Stephanie Kersten-Johnston, an adjunct professor in the Sustainability Management program at Columbia University and director of sustainable business at Heineken USA, explained that "highest value" means what's closest to the original product, in order to get the most out of the embedded value in the material and the labor that went into creating the product. Europe has made the circular economy a goal for the whole continent.

Using the example of cell phones, Kersten-Johnston explained how the electronics industry could move towards a circular economy. "Right now, over the length of the contract, you gradually buy outright the phone so the provider can recoup the cost of manufacturing that phone in the first place," she said. "But at the end of the contract, you're left with a phone that's worth basically nothing, that you've had to pay for all that time and you can't do anything with it. That's a flawed model. But imagine a system where the provider or manufacturer retained ownership of the device through the contract so customers would pay a lower monthly fee and be expected to return the device for an upgrade. The value could be recaptured in the form of parts for remanufacture or materials for recycling, and customers would still get their upgrades."

Kersten-Johnston believes it's only a matter of time before this type of business model happens across the board because millennials and the younger generation don't value ownership in the same way as previous generations, and they expect this type of responsible behavior from industry.

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What you can do about e-waste

The best thing you can do is to resist buying a new device until you really need it. Try to get your old product repaired if possible and if it can't be fixed, resell or recycle it responsibly.

Before you recycle your device, seal up any broken parts in separate containers so that hazardous chemicals don't leak. Wear latex gloves and a mask if you're handling something that's broken.

Find a responsible recycler. Recyclers with the [E-Steward](#) label on their websites have been certified to meet the cleanest and most responsible standards for e-waste recycling. E-Steward recyclers also clear your data in their recycling process.

Resources

60 Minutes: [The Wasteland \(e-waste in China\)](#)

Find places to recycle near you through [Consumer Resources](#), [Recycle Electronics](#)

All about e-waste in [New York City](#)

New York State e-waste [collection sites](#)

[Best Buy](#) and [Staples](#) recycle e-waste, as do [Goodwill](#) and the [Salvation Army](#).

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Lu Prescott

🕒 3 years ago

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A humorous look at a not so funny problem.

<https://luprescott.myportfolio.com/factory-workers>

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Velu Sharma

Reply to Lu Prescott

3 years ago

How to recycle please
I am living india

Reply



Jushey

Reply to Velu Sharma

3 years ago

Visit <http://www.cleantogreen.in>

Reply



Norman Stokes

3 years ago

Growing e-waste problem is a paramount concern and most of the people are not aware of how they can contribute to reduce this problem. Your blog gives comprehensive details on what people can do to handle the e-waste growing issue. More and more readers can become familiar with the e-waste, its upsurge, the state of e-waste recycling and what they can do. Extremely informative blog.

Reply



Kunal Gopalani

3 years ago

it has become important, these days to rationalise electronic waste management systems for the environment to be preserved and health hazards to take a slump.

Reply

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Robert Callaghan

3 years ago

If you are 15 years old, emissions rose 30% in your lifetime.

If you are 30 years old, emissions rose 60% in your lifetime.

In the next 10 years, emissions will rise 10% at least.

After 30 years of trying, solar and wind are 2% of total world energy use.

To avoid 2 C, emissions must drop 50% in 10 years, and 100% in 20 years.

5 of 13 major tipping points are triggered like dominos below 2 C.

When these 5 tipping points begin, they reinforce each other and trigger the other 8.

Runaway hothouse earth cannot be stopped or reversed once started.

The earth will take many, many thousands of years to recover.

Runaway mass extinction cannot be stopped or reversed once started.

The earth will take many millions of years to recover.

Nobody wants to admit it.

There are 25 billion chickens on earth.

Humans and livestock are 98% of all land vertebrate biomass.

10,000 years ago, humans and livestock were 0.03% of all land vertebrate biomass.

All male vertebrates are being biologically emasculated, feminized, sterilized, stupified and crazyfied.

If you want tons of data on how and why, go to Loki's Revenge Blog and read: The Withering Bones of Humanity

↪ Reply



Jack

🕒 3 years ago

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I think collaboration between the governments of developed and developing countries can help humanity get rid of e-waste. Researchers should also try their best to develop ways to significantly or completely reduce the inclusion of toxic materials in electronic devices.

Reply



Matt Wattel

3 years ago

Here is another possible resource that could be of use to you.

1-800-GOT-JUNK? offers an FAQ page on how to dispose of electronic waste. The resource goes over how to recycle electronics, the importance of properly disposing of electronic waste, and other need-to-know information before throwing away electronics.

Below is the URL to 1-800-GOT-JUNK?'s Electronic Waste FAQ page:

https://www.1800gotjunk.com/us_en/what-we-take/electronics-recycling

I hope this helps!

Reply



Chase

3 years ago

I have some questions about e-waste if anybody could respond that would be great! It is for a school project and I want to learn more about it!

Reply



Adhwaith Srikanth

Reply to Chase

1 year ago

Is this Zachariah Chase? This is Adhwaith man!

Reply

22




chase

3 years ago

Can anybody answer some questions about e-waste

 Reply


Collard Matthews

 Reply to [chase](#) 1 year ago

What are your questions?

 Last edited 1 year ago by Collard Matthews Reply


Çevre Bilinci

 2 years ago

Here, in Turkey also this is a big problem. Municipalities are top collectors but it's not still on a good path. EcoATM seems a good action on that.

 Reply


Sara James

 2 years ago

A majority of nations across the globe have regulated electronic scrap generation and their treatment procedures. For instance, the European Union (EU) has authorized all electronic goods manufacturers to undertake the responsibility for the treatment of end-of-life products. <http://bit.ly/2QAM9I8>

 Reply

Karan Joshi

 2 years ago

22

yes, you are right. e-waste is a huge problem for an environment and also for humans. We have to be aware of that. Thanks for sharing important knowledge to everyone.

 Reply

Lazarus Boshielo



🕒 2 years ago

Hi! I'm living in South Africa Enquirer for knowledge and tips on how to start e waste In my country.i resides in rural areas where we are not exposed to e waste,we end up throwing away recycleble items

➔ Reply



Elizabeth

🕒 2 years ago

This is a very good article, however, in Nigeria where i reside, not only is the awareness about the dangers of e-wastes low, there is also no known e-wastes recycling plant in the country, so you can imagine the situation of things here. As a PHD student with interest in this area, i'll like to know what steps to take beyond writing. Thanks

➔ Reply



Trashvocacy

🕒 2 years ago

Market competition makes a difference on how these gadgets have been made and sold in the market. Also, the needed infrastructure, working capital, and most importantly the skills required to recycle electronic gadgets are scarce in developing countries. Nonetheless, avenues for proper disposal of these wastes is non-negotiable. At Trashvocacy here is what we do at Trashvocacy
<https://www.trashvocacy.com/>

➔ Reply



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Rebecca Gardner

🕒 1 year ago

It's good to know that E-products need to be recycled responsibly in the event that they can't be repaired. My husband and want to start cleaning out some of the junk in our garage, including an old desktop computer that's too far gone to be fixed. I'm glad

I read your article so I can do the responsible thing and look for a computer recycling service in our area to give it to.

➔ Reply



zander

🕒 1 year ago

Mabey to help this we can remake new stuff with these things like to make it again.

➔ Reply



Matthew Adah Onu

🕒 4 months ago

Hello,

Goodday, I would like to know if I can make use of any of the photos for research article in my upcoming book chapter.

Thank you.

➔ Reply



Sarah Fecht Admin

🗨️ Reply to [Matthew Adah Onu](#)

🕒 4 months ago

Hi Matthew, we do not own the images in this post — you'd have to reach out to the original creators, which are linked in the image captions. Best of luck with your book chapter!

➔ Reply

