

CHAPTER 15

ELECTRONICS MATERIALS MANAGEMENT

INTRODUCTION

From giving rhythm to the pulse of a person's heart to connecting remote communities around the world, **electronics** are increasingly an essential aspect of everyday life.



TERM

Electronics are defined as any device (television, radio, computer, appliance etc.) that operates with an electrical current and often has small working parts such as microchips.

Special attention should be paid to electronics when talking about materials management, in part, simply because they are so prevalent. Electronics are also important because their environmental and social impacts are uniquely troubling all along the materials life cycle.

This chapter will demonstrate the social and environmental impacts related to electronics as well as explore choices that we can make at home and at work to reduce these negative impacts. The chapter will also explore various policies and programs (proposed and existing) focused on reducing the negative impacts of electronics.

LIFE CYCLE OF ELECTRONICS

Electronics require a wide range of raw materials that must be extracted from the earth. Barium, beryllium, cadmium, copper, gold, lead, mercury, nickel, and oil and natural gas are all commonly used in producing electronics. These materials carry with them a wide range of problems at each stage of the life cycle.

Environmental and health impacts of mining and manufacturing electronics

The mining of raw materials for electronic products contributes to increased respiratory problems for workers, such as silicosis, tuberculosis, bronchitis and lung cancer. Mining pollutes the water of surrounding communities through cyanide-contaminated waste ore and other mine wastes including toxic metals and acids, which often get released into lakes, streams and oceans, killing fish and contaminating drinking water. This water pollution is especially concentrated in communities rich in these minerals and/or without the power to control how they are managed.

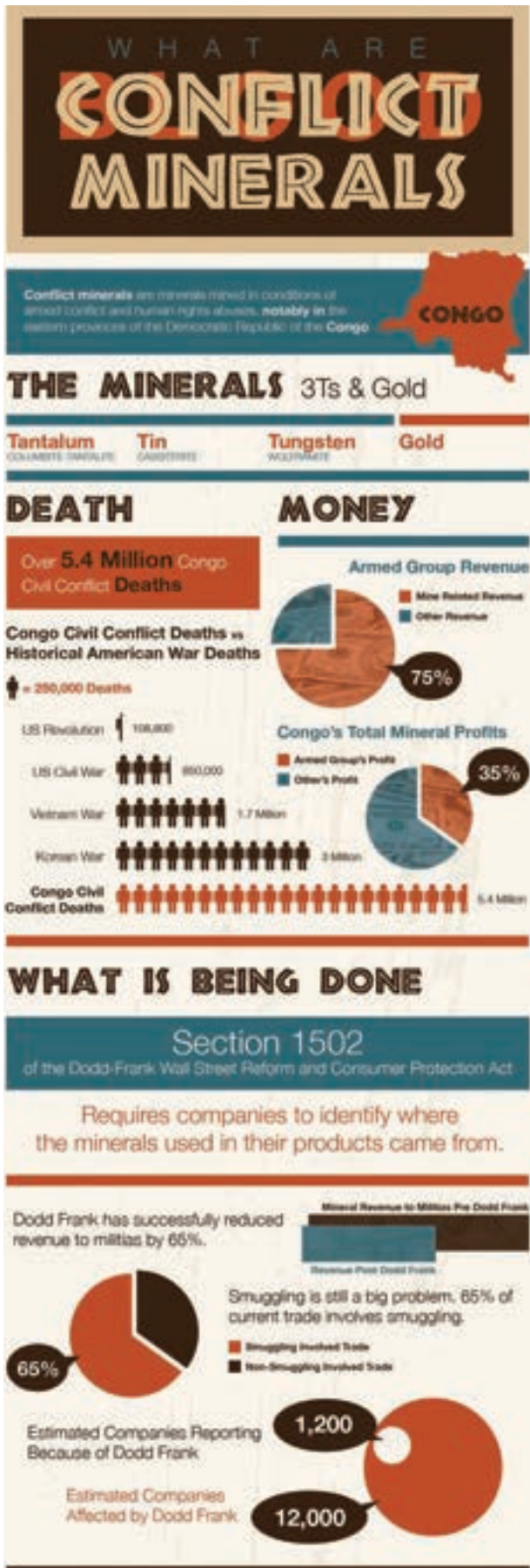
The United Nations estimated, for instance, that by 2008, ninety percent of El Salvador's surface water was contaminated by gold mining pollution (UNICEF 2010). The Acelhuate River is so contaminated with heavy metals and industrial waste that it is considered a biohazard.

Many of these toxic materials are delivered in a raw state to manufacturing facilities in the United States and abroad. Workers in these settings experience the same types of illnesses as those who are exposed in the mines. Even workers in the United States will, for instance, use cadmium, a known carcinogen as a solder for circuit boards and other metal parts. The EPA regulates U.S. business and has established an allowable level of the cadmium to be released in the drinking water, soil and air. The same cannot be said for factories around the world.

Conflict and minerals

The intense need for inexpensive raw materials for electronics creates social conflict in communities affected by polluting mines. Communities can become displaced when their waterways are poisoned and also when mining companies need to expand or build infrastructure to move the extracted materials. When people try to protest in the countries that have repressive governments, they experience imprisonment, murder and physical removal.

What's perhaps even more troubling than social problems caused directly by mining is how the income from mining is often used to buy weapons that then support repressive governments, fuel wars and arm violent militia groups. This phenomenon has been coined *conflict minerals*.



Source: www.sourceintelligence.com/what-are-conflict-minerals/

In the past 15 years the mining of metals for electronic products has been fueling a civil war in the Democratic Republic of Congo (DRC) that has resulted in the loss of more than five million lives and involved human rights violations including mass murder and rape. The government and rebel armies both finance their operations through mining tin, tantalum and tungsten (known as the 3 Ts), as well as gold, for use in our cell phones, laptops, MP3 players and game devices.

Use phase

The impacts of the use phase are often overlooked as we tend to focus more on extraction and production as well as downstream activities such as landfilling and recovery. Electronics require energy for operation, so the use phase has significant ongoing impacts.

Planned obsolescence

The use phase is, however, often unnaturally shortened due to what is known as planned obsolescence. You have encountered planned obsolescence if you have ever updated your phone or computer, only to find that afterward the hardware no longer works well with the new software. Companies frequently make it so that the latest version of software is not compatible with earlier versions. While electronics is a rapidly innovating field, companies often have a vested interest in shortening the useful lifespan of a device and forcing consumers to buy a new one before it has actually worn out.

TERM

Planned obsolescence: An intentional policy by manufacturers to plan or design a product so that it loses its value, becomes outdated or out of fashion, and/or ceases to work after an expected period of time or use in order to increase profits.

RESOURCE

For more on the Electronics Disposal Ban visit the Oregon E-Cycles webpage.

E-waste

E-waste is discarded electronics, and it includes materials destined for reuse, resale, salvage, recycling or disposal. Due to the high number of toxic chemicals involved, as well as the high value of materials embodied in these discards, disposal and recovery of e-waste takes on more significance than most other waste streams.

Toxics and e-waste

Since certain components of electronic devices may be considered hazardous due to heavy metal or other potentially dangerous elements, the end-of-life handling of some electronics discards is regulated by either federal (Resource Conservation and Recovery Act--RCRA) or state (Department of Environmental Quality) hazardous waste laws, or both. Managing these special materials is costly with the burden falling mostly on the consumer and local governments.

Oregon regulations regarding the proper management of Cathode Ray Tubes (CRT), found in older technologies for computer monitors and televisions, took effect in 2010. Oregon law now prohibits computers, laptops, monitors, and TV sets regardless of display style or technology (CRT or flat screen display) from being landfilled. Violators of this ban could face stiff fines of up to \$500 for each prohibited item disposed of improperly.

Problems with overseas recovery

Recovery of materials that go into electronics is an important way to interrupt the need for extraction of minerals to make new electronics. Recycling and reuse save energy in the manufacturing process. Extracting precious metals can also offer great economic benefits.

Unfortunately, because of the extra burden of managing the hazardous materials in e-waste, much of the recovery has taken place in countries where wages are extremely low and working conditions dangerous. The EPA estimates that in 2010 as much as 50-80 percent of e-waste recycling and reuse was exported.

The Basel Action Network (BAN) is a non-profit organization that exposes what they term, the “devastating impacts” of this toxic international trade. BAN offers education programs like their films “Exporting Harm” and “Digital Dump” to expose the impacts of e-waste that arrives every year in China and Africa. In these films, we follow the brokers to small towns where families are dismantling electronics with bare hands and rudimentary tools, melting heavy metals in their front yards and burning piles of e-waste plastics.



The Digital Dump, Illegal Electronics Waste Trade in Nigeria, a documentary

Along with education, BAN organizes the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal. The Convention gathered signatory nations for a treaty that was adopted in Basel, Switzerland on 22 March 1989. The Convention was initiated in response to numerous international scandals regarding hazardous waste trafficking that began in the late 1980s. To date, the Federal government of the United States is not a signatory to this treaty.

Digital safety

One area that sometimes gets overlooked when discussing e-waste is digital safety. From your phone to your personal computer, most households, businesses, non-profits and public agencies rely on their electronics to store sensitive data such as names, addresses, social security numbers, correspondence, medical or mental health records. Just because an electronic device is deemed replaceable does not mean that the data on it is not still easily accessible. Information security breaches can have major legal and financial ramifications.

According to TechSoup.org, there are two best choices to eradicate data. Before donation, recycling or disposal, one can either physically destroy the hard drive or wipe the data with software designed to completely wipe the data clean. The first option is the best when the hard drive is no longer reusable. Some might be tempted to simply reformat a hard drive or delete files. Techsoup.org recommends avoiding these options as they do not thoroughly destroy the data.

Better yet, there are many software programs online that will help destroy the data before the machine is out of your hands. Disk-wiping software works by overwriting the *ones and zeros*, that make up your data with random information (new *ones and zeros*).

Consumers should ask about the policies of depots for recycling and reuse to understand how they might destroy the data.

DEEP DIVE

Learn more about the Basel Network on their website.

Exporting Harm and Digital Dump are both videos you can check out in the Master Recycler Library or watch on YouTube.

TAKING CONTROL OF THE ELECTRONICS PROBLEM

The ubiquitous nature of electronics, the constant need for the most up-to-date technology and their devastating social and environmental impacts can create a feeling of helplessness for the concerned consumer. There are, however, choices that we can make at home and at work to strike a better balance. There are also important policies we need to understand, support and strengthen if we want to address the problem at the global level.



Consumer choice

There are a number of efforts to empower the consumer to better understand the problems related to electronics as well as weigh the impacts of differing products.

EPEAT

EPEAT (Electronic Product Environmental Assessment Tool) is a comprehensive global environmental rating system that helps purchasers identify greener computers and other electronics.

The EPEAT system was developed and is managed through an open process involving representatives from all stakeholder groups. Manufacturing, environmental advocacy, academic, trade association, government and recycling entities all actively participate.

Products are measured against both required and optional criteria. A product must meet all of the required criteria in its category to be added to the registry. It is then rated Bronze, Silver or Gold depending on how many of the optional criteria it meets. Bronze-rated products meet all required criteria, Silver-rated products meet all required criteria and at least 50 percent of the optional criteria, and Gold-rated products meet all required criteria and at least 75 percent of the optional criteria.

EPEAT product criteria include several categories of environmental attributes and cover the full life cycle of electronic products. *The PC and Displays, Imaging Equipment, and Televisions standards address:*

- Reduction/elimination of environmentally sensitive materials
- Material selection
- Design for end of life
- Product longevity/life extension
- Energy conservation
- End-of-life management
- Corporate performance
- Packaging
- Consumables (unique to Imaging Equipment standard)
- Indoor Air Quality (unique to Imaging Equipment standard)

Conflict Minerals

The Enough Project works to raise awareness of conflict minerals and offer resources to help colleges, cities and individual consumers minimize the chances that electronics that they purchase are made with conflict minerals.

ENERGY STAR

As previously mentioned, one of the most important impact stages in the life cycle of electronics is the use phase. In short, it takes energy to run electronics. So it is important that consumers think about the energy efficiency of products when making purchases. Happily, there is a well-established tool to help consumers in this area.

ENERGY STAR is a U.S. Environmental Protection Agency voluntary program that helps businesses and individuals save money and protect our climate through superior energy efficiency. Now in its 20th year, the ENERGY STAR program has boosted the adoption of energy efficient products, practices and services through partnerships, objective measurement tools and consumer education.

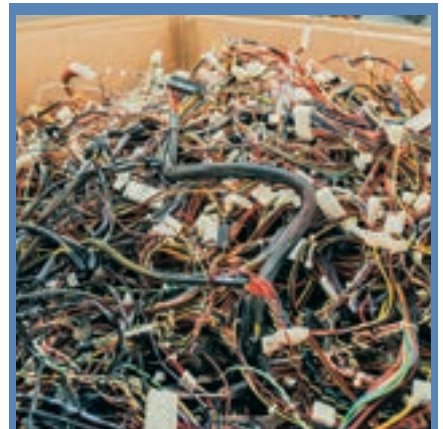
When consumers are done using high energy use products, they should also put careful consideration into whether it is better to recycle the product rather than offer it for donation and reuse where it will continue to use high levels of energy.

E-waste certification programs

While EPEAT helps consumers think about better purchasing options, and Energy Star ensures that the use phase is efficient, there are also programs designed to inform consumers about choices for the ultimate disposal of unwanted electronics.

According to the EPA, consumers can effectively reduce environmental and human health impacts from improper recycling by choosing electronics recyclers who demonstrate to an accredited, independent third-party auditor that they meet specific standards to safely recycle and manage electronics. Currently two accredited certification standards exist on a national level: the Responsible Recycling (“R2”) Standard for Electronics Recyclers and e-Stewards®.

Both certification programs share common elements that ensure responsible recycling or reuse of electronics. These programs advance best management practices and offer a way to assess the environmental, worker health, and security practices of entities managing used electronics. Specifically, these certification programs are based on strong environmental standards which maximize reuse and recycling, minimize impacts on human health or the environment, promote safe management of materials by downstream handlers, and audit the destruction of all data on used electronics.



DEEP DIVE

You can learn more about **e-Stewards** on their website and you can learn more about the **R2 Standard** on the website of Sustainable Electronics Recycling International.



Certified electronics recyclers have demonstrated through periodic audits and other means that they continually meet specific high environmental standards and safely manage used electronics. Once certified, the recycler is held to the particular standard by continual oversight by the independent accredited certifying body.



As a consumer, it is not necessarily important to understand the difference between R2 and eStewards certification. eStewards certification costs more and covers more, but R2 certainly shows commitment to sustainability. Some processing companies find value in having both certifications.

Oregon E-Cycles

Oregon E-Cycles is a program managed by the Oregon DEQ that enforces both the management of e-waste and also producer responsibility.

The program is a producer responsibility program in that it ensures that anyone who sells a new computer in Oregon participates in the costs of the resulting e-waste. DEQ also created specific environmental criteria for each of the participants in the Oregon E-Cycles program including the collectors, the transporters, the processors and the manufacturers. When the public brings electronics into an authorized collector, they can know that strict environmental handling procedures are followed at all levels.

Anyone in Oregon can take seven or fewer computers (desktops, laptops and tablets), monitors, TV's and printers at a time to participating Oregon E-Cycles collection sites for free recycling. Computer peripherals (keyboards and mice) are also accepted free of charge. Other types of electronics are currently not included in this program. However, many of the collection sites also accept other electronics.



DEQ's Monster in your Closet campaign encourages people to properly dispose of e-waste lurking in their homes.

U-waste

There are many products that have similar, if not the exact same, end-of-life problems as e-waste. Objects like fluorescent bulbs, batteries and ballasts may not be electronic, but they have toxics and are expensive to landfill or recover. A growing number of e-waste processors are finding innovative and safe ways to also manage these discards. They have begun to use the term u-waste (or Universal Waste) to describe them. Households should take these products to one of the Metro hazardous collection sites, and businesses can contact Metro's Recycling Information Center (503-234-3000) to identify a local company that can accept u-Waste for recovery or proper disposal.

Three ways to tackle planned obsolescence in electronics

Fortunately, consumers are not entirely at the whim of planned obsolescence. There are a few strategies that can ensure the longest possible lifespan for your electronic devices.

1. Use Open Source Software

Mainstream software companies such as Apple and Microsoft keep proprietary rights to their software. The exclusive copyright owners license out the use of their software usually with only limited conditions of use.



Often when these companies release a new version of software it triggers a domino effect that renders hardware and accessories obsolete. With a closed software system the only people consumers have to go back to get repairs, tech support and updates are the same people that have a vested interest in your giving up and buying a newer product.

Open source software is a way out of this march to the great digital dump. Open source software is designed by a community of developers who agree to openly share the source code (or internal workings) of the software. To be called open source, software must allow for free redistribution, allow others to modify the software, must work on any platform and needs to not restrict other software from working. The definition of open source is maintained by a non-profit organization called Open Source Initiative. They have a compliance/certification process. However, the main power behind open source is peer review. The open source community is constantly tinkering, creating new add-ons, solving problems and then sharing the results. Program developers set up feedback loops so that new ideas can improve the existing programs.

Free Geek in Portland is a great place to learn more about open source. They offer community classes on the operating system called Linux Mint that they install on all of their computers.

TERM

Open Source Software

is computer software that is released under a license in which the copyright holder grants users the rights to use, study, change, and distribute the software and its source code to anyone and for any purpose.

2. Prolong the life of your products

Read up on the best ways to extend the life of your electronics and their batteries. Here is an example of how the EPA suggests making your smart phone work better and last longer. When you make a purchase, ask questions and look up information to learn similar tips for other products.

- Choose your service provider carefully. Many companies sell their own phones which are not always transferable between companies.
- Select a phone with features you need and a style you like so you'll keep it longer.
- Take care of your phone. Use a case, keep out of extreme temperatures and avoid water.
- To extend your phone's battery life, limit location services, reduce brightness, switch to airplane mode when out of range, close unnecessary apps and turn auto updating off.
- Don't worry about overcharging. New smartphones with lithium-ion batteries don't have a problem with partial discharges. In fact, charging a little at a time, instead of draining the battery all the way down, will help preserve your overall battery life.



Learn more in *Shady World of Repair Manuals: Copyrighting for Planned Obsolescence* published in *Wired Magazine* (available online).

3. Fix your electronics

Large electronics manufacturers don't want you to know that it is actually pretty easy to fix a lot of the gadgets we have around us. If you knew that, it would slow you down from buying more of their products. Companies have gone so far as to make it nearly impossible for a consumer to get their hands on an owner's manual which would help them understand how things work and can be fixed. Blocking access to information about products can negatively affect the repair shop economy. One Australian tried to create a website for fellow repair companies that posted the manuals of electronic products. Toshiba sued and won for infringement of copyright.

Despite these roadblocks, many electronics are worth attempting to fix. Here are some resources that may be worth investigating before giving up on a broken electronic device:

iFixit is a global community of people helping each other repair things. Their website includes manuals (either found online or created by iFixit volunteers who take things apart and write manuals about how things work), a forum to ask questions, and a store for tools and parts.

Not up for taking on the task yourself? **RepairPDX.org** organizes free events that bring volunteers who like to fix things together with people who have broken items that need fixing. Experts are on hand to fix items as well as teach participants how to fix their own items. Most events will have people who know how to use a sewing machine and soldering iron. There may also be cobblers.



There are dozens of small businesses in the metro area that repair many types of electronics. It is a common myth that taking electronics to these places costs more than simply buying a new product. While this can sometimes be the case, it is often cheaper. If you weigh the full environmental and social costs of making and discarding electronics, a quick repair is often worth it.



➤ **RESOURCE** ◀

You can learn more on
iFixit's website.

➤ **RESOURCE** ◀

You can learn more on
Free Geek's website.

**FREE
GEEK**

When asked why businesses should choose to recycle e-waste properly even if it isn't required Jason Kragarud, e-waste processor at Universal Recycling Technologies, says, "Two reasons, well, probably three: 1) peer pressure, i.e., if NIKE leads the charge, other shoe companies will feel they have to follow along, 2) media pressure, i.e., if you get caught sending e-waste to Third World Countries, the media will be all over you, and lastly, 3) it's the right thing to do."



DEEP DIVE

To learn more about proposed legislation and how you can support it in Oregon, visit the Association of Oregon Recyclers online.

Electronics legislation

Product stewardship and e-waste laws

Product stewardship laws set up mechanisms and requirements where manufacturers participate in the management (or at least the cost of the management) of the whole life cycle of a product. These laws are often also called Producer Responsibility laws. Currently 25 states in the U.S. have some kind of electronics product stewardship law.

Each state has tackled the problem slightly differently. The largest number of them (including Oregon) have introduced *consumer take back* programs where electronic product manufacturers finance and provide a statewide program to take back unwanted electronic equipment from consumers. There is no fee charged when the product is taken in for recycling; rather that fee is included in the price of the product or is charged when the product is purchased. These programs usually include the support of a collection system so that consumers throughout the state can identify nearby locations to safely discard their electronics.

As these types of laws increase, manufacturers will share the burdens associated with energy use, recycling and disposal of their products. This could encourage the companies to design products to last longer, use less energy and be easier to open and replace parts for repairs.

Some states (like Washington) have only passed producer responsibility laws. These laws make it easier for people to recycle because they remove the cost barrier. Some state electronics discards laws (like Oregon's) combine producer responsibility and regulation of discards along with a ban on electronics landfilling.

The Oregon E-cycles program collected 26,225,761 pounds of electronic devices in 2016. That's around 6.41 pounds per capita. When the law first went into effect in 2010 there was a flood of old electronics that people had stored in their basements waiting for a free and reliable way to recycle them. Oregon is probably approaching the peak in terms of pounds of electronics collected per year for two reasons:

1. Most of the old electronics people were storing have now been collected, and what's now being collected is primarily end-of-life material.
2. Electronics are changing to be much lighter but also harder to take apart.

Electronics and the right to repair

A second intriguing front of electronics legislation focuses on preserving consumers' rights to repair the electronic products they have purchased. Kyle Wiens, founder of iFixit.org and the author of the Repair Manifesto, feels that the individual's right to repair is under assault. He points out that manufacturers are shifting their practices in a way that takes repair out of the equation. They have increasingly stopped making replacement parts, they frequently design products that break if you try to open them, and they often make specialized parts that cannot be replaced with universal ones. Wiens also points out that manufacturers have begun to claim proprietary rights to manuals and electronic chips that make these products run. Wiens states in Wired Magazine:

"Over the last two decades, manufacturers have used the DMCA (Digital Millennium Copyright Act) to argue that consumers do not own the software underpinning the products they buy — things like smartphones, computers, coffeemakers, cars, and, yes, even tractors. So, Old MacDonald has a tractor, but he owns a massive barn ornament, because the manufacturer holds the rights to the programming that makes it run."

If companies are able to successfully make this claim, then customers would be left unable to repair and maintain their electronics. This will increase purchases of new electronics and increase the negative environmental impacts associated with electronics manufacture and use. Lack of access to product manuals and parts also makes it so that local repair service shops would not have the tools they need to do their work. Kyle Wiens argues that the gradual shift from a repair service model to a throw away and purchase new model is also a shift from local businesses to international businesses in which workers may be subject to slavery and dangerous conditions.

Consumers and local businesses are beginning to tackle this problem. For example, in 2012 88 percent of voters in Massachusetts overrode the car companies and passed the automobile owners' Right to Repair law which requires motor vehicle manufacturers to allow vehicle owners and independent repair facilities in Massachusetts to have access to the vehicle diagnostic and repair information.

In 2015, the Digital Right to Repair Coalition worked with allies on the ground to introduce pro-repair legislation at the state level in New York and Minnesota. *Fair Repair* would do just what the name implies: it would make repair fair again. Fair for owners of digital equipment. And fair for independent repair facilities. If made law, Fair Repair would require manufacturers to provide owners and independent repair businesses with fair access to service information, security updates, and replacement parts.



DEEP DIVE

Learn more in ***We Can't Let John Deere Destroy the Very Idea of Ownership*** published in **Wired Magazine** (available online).

RESOURCE

You can learn more about *Fair Repair and the Right to Repair* movement on *iFixit's* and *The Repair Association's* websites.



CONCLUSION

While electronics have transformed our everyday lives they are also substantially transforming our earth. From extraction to end of life, electronics have many negative environmental and public health impacts. The minerals and metals required for electronics manufacture are hazardous to extract from the earth. Moreover, the profits generated from these activities are sometimes used to fund wars or support dictatorial or corrupt governments. Once the manufacturing stage is complete, it takes a great deal of energy to power our proliferating electronic devices. These devices tend to have relatively short lifespans, in part because of rapid technical innovation, but also due to planned obsolescence. As devices are replaced, old devices containing toxic materials can end up in the landfill or be disassembled overseas where there are few measures to ensure worker safety and public health.

Despite this daunting array of problems, promising solutions and strategies are emerging. Certification and rating programs can now help consumers avoid conflict minerals and purchase electronics that are less environmentally impactful. Electronics recycling is more widespread and many states now require manufacturers to fund free electronics collection programs. Individuals are discovering ways to prolong the life of their electronic devices and vibrant open source communities are creating free software that can avoid situations in which a new version of commercial software will not function on older hardware.

While these developments are promising and encouraging, the U.S. still lacks cohesive federal policies and legislation regarding electronics manufacturing, engineering and disposal. Only half of the states have passed electronics product stewardship laws. The right to repair may also be under siege, as some companies are claiming that the underlying software that makes a device or appliance run is proprietary. If such claims stand up to legal challenges then consumers and repair shops would be left unable to fix or maintain electronic devices.