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Special Report

Recycling Electronic Waste



INTRODUCTION

Recycling Electronic Waste

The rapid pace of technological progress has revolutionized any number of industries. It has also generated a huge and rapidly growing toxic waste stream that threatens people's health, the environment and even national security. This report looks at the scale and nature of the challenges posed by e-waste and how they might best be met.



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Millions of tons of electronics are tossed out each year. A small percentage is collected and responsibly reused or recycled, but most is not. An alarming amount ends up in developing countries where thousands earn their livelihood by extracting precious metals using medieval techniques that ruin their health and despoil the environment. Some steps have been taken to remedy the situation, but with limited success. Meanwhile, national security concerns have arisen as improper recycling of e-waste puts sensitive data at risk and enables the production of unreliable counterfeit components that are used by the U.S. military.

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More than \$20 billion in gold and silver is used each year to manufacture new electronic devices. Until relatively recently, the recovery of those precious metals and others fueled e-waste recycling efforts. But falling commodity prices have wreaked havoc in the recycling industry, as have ever-thinner, more sophisticated products that make it increasingly difficult to extract what little valuable material is inside. A few retailers are helping consumers responsibly recycle, some manufacturers are designing products for easier recycling and some companies are facilitating the reuse of discarded products. Key to these efforts is the ability to prevent stored data from being scavenged.

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Recognizing the need for responsible recycling of electronics, the U.S. Environmental Protection Agency along with state regulators, the private sector and nonprofits established the R2 protocol — a set of best practices to be adhered to by certified recyclers. Now administered by Sustainable Electronics Recycling International (SERI), R2 has certified more than 500 recyclers around the world. The Basel Action Network (BAN) participated in the EPA's R2 process, but broke away from it after two-and-a-half years, claiming it was insufficient. One difference with R2 is that it would ban any export of toxic e-waste to developing nations. BAN became a competing standard known as e-Stewards. However, having two rival certifications can be confusing, leaving recyclers unsure about which route to take.

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The United States has no federal law governing e-waste recycling. A bill introduced in 2013 has never had a hearing. Lacking federal leadership, many states have enacted regulations of their own. While almost all rely to some extent on funding by manufacturers, differences among the approaches offer valuable lessons about what kinds of recycling regulations work best. But none have the authority needed to govern international activities or the clout to seriously influence manufacturing practices.

SPONSORS

The Initiative for Global Environmental Leadership (IGEL) and Electronic Recyclers International, Inc. have partnered to create this special report.





Meeting the E-waste Challenge

THE AVERAGE SMARTPHONE WEIGHS ABOUT FIVE OUNCES; a tablet, less than two pounds. Yet in 2014, the world threw away 41.8 million metric tons of electronics. That figure includes more than just smartphones and laptops, of course. Electronic waste, or e-waste, is composed not only of phones, computers, tablets, TVs, printers, scanners and all things digital; it also includes “almost any household or business item with circuitry or electrical components with power or battery supply” — everything from lamps to clothes dryers — according to the United Nations University report, “Global E-Waste Monitor 2014.” The United States and China together generate nearly a third of the global waste stream (7.1 million and 6.0 million metric tons from the U.S. and China, respectively).

What happens to all this e-waste? Only 16% of the world’s e-waste was recycled by officially sanctioned government or commercial enterprises in 2014, says the UN report. The rest followed one of three paths in the developed world:

- Some e-waste was simply put in the trash and ended up in a landfill or an incinerator.
- Some was collected by individuals or private companies outside of official recycling systems (a portion of this e-waste was refurbished for resale or processed into separate materials).
- Much of what remained entered a secondary market for used electronics and raw materials in the developing world

The details of this secondary market are murky. While there are international rules governing e-waste recycling (discussed elsewhere in this report), there is also a great deal of illegal activity. In fact, up to 90% of global e-waste, worth nearly \$19 billion, is illegally traded or dumped

each year, according to a report by the United Nations Environment Programme (UNEP). When Interpol agents checked containers leaving the European Union in 2013, for instance, they found almost one in three contained illegal electronics. That same year, a Colorado-based recycling company was fined \$4.5 million and two of its executives were jailed and ordered to pay fines and restitution for illegally shipping e-waste out of the country between 2005 and 2008. Most of what they shipped, which included more than 100,000 cathode ray tubes averaging about 2.5 pounds of lead each, went to China.

The average smartphone weighs about five ounces; a tablet, less than two pounds. Yet in 2014, the world threw away 41.8 million metric tons of electronics.

Another path e-waste can take in the developing world is commonly referred to as informal recycling. “In most developing countries, there are an enormous number of self-employed people engaged in the collection and recycling of e-waste,” noted the UN report. “They usually work on a door-to-door basis to buy e-waste from consumers at home, and then they sell it to refurbishers and recyclers. These types of informal collection activities provide the basic means necessary for many unskilled workers to pay for their living.”

According to John Lingelbach, executive director of Sustainable Electronics Recycling International (SERI), the nonprofit group that manages the R2 e-recycling

standards, informal recycling is a vague term that includes some potentially worthwhile activity. He points out that the term refers to activities that pose serious health and environmental risks, but is “also used for companies, in India for instance, that have a building where they’re dismantling electronics and then sending that on to the formal sector, to established companies.” Lingelbach explains that these businesses are called informal “because they are sort of underground: They don’t have regulatory permits, or business permits and are probably not paying taxes.” Citing the potential of these informal recyclers to extend the lives of usable electronics, Lingelbach says that SERI has made improving the performance of the informal sector part of its mission.

Women were heating circuit boards over a coal fire, pulling out chips and pouring off the lead solder. Men were using what is literally a medieval acid recipe to extract gold.

Robin Ingenthron, CEO of Good Point Recycling in Burlington, Vermont, is working towards the same end. His firm exports used, working laptops to Ghana. “People in the West forget that if they send something to Ghana, it’s used a lot longer than it is back home,” he explains. “Where I come from, that’s considered good for the environment.”

The problem, famously documented in the CBS News show “60 Minutes” in 2008 (and cited in numerous accounts ever since), is that whatever these informal recyclers cannot sell generally ends up in places like Guiyu in southern China, where “women were heating circuit boards over a coal fire, pulling out chips and pouring off the lead solder. Men were using what is literally a medieval acid recipe to extract gold.”

This primitive treatment of 21st century electronics resulted in a six-fold increase in miscarriages among the women of Guiyu, unhealthy levels of lead in 70% of the children and the highest levels of the pollutant dioxin in the world. Tragically, similar scenes can be found in Africa — Agbogbloshie in Accra, Ghana, has appeared often in the press — and elsewhere in the developing world.

IT’S COMPLICATED

Some progress is being made. At one point, it was estimated 70% of the world’s e-waste passed through Guiyu, but a recent report by Bloomberg BNA revealed, “What at its height was a bustling yet heavily polluted town, with 5,000 or more informal e-waste workshops and dismantling facilities, has been cleared out as part of China’s ‘war on pollution.’”

While “relieved that the cleanup has finally begun,” Jim Puckett, executive director of the Basel Action Network, has voiced concerns about where all the e-waste from the developing world is now going, if it’s not going to Guiyu. According to some reports, e-waste is now also being dumped in Taiwan, Hong Kong, Thailand and other Asian destinations.

Agbogbloshie also seemed to be headed in the right direction. On June 25, 2015, Pure Earth, an international nonprofit organization, reported good news about the first phase of a pilot project designed to improve conditions at the site without eliminating jobs. A modern e-waste recycling facility, capable of extracting copper from cables and wires without emitting toxic fumes, has opened. Local people would still be able to earn a living as informal recyclers but at much less risk to their health.

But despite the new initiative, that same year, Accra’s government, apparently unnerved by the international attention the e-waste issue was getting, took violent action to shut down the entire Agbogbloshie market, destroying a neighborhood children’s center in the process.

E-WASTE AND NATIONAL SECURITY

The e-waste challenge extends beyond environmental and human rights concerns. In recent months, a focus on national security has attracted interest in e-waste from new constituencies. In the past, explained John Shegerian, co-founder, chairman and CEO of Electronic Recyclers International (ERI), concern over illegal dumping tended to split “almost ideologically.” But when illegal dumping of e-waste jeopardizes national security, everyone takes notice. “No one wants our homeland security to be breached,” said Shegerian.

The first threat concerns data. Shegerian said representatives from both the U.S. Department of Homeland Security and the FBI have told him that the government in Washington today has no statutory way of disposing of their electronic assets. And when electronics

are improperly disposed of, they tend to be shipped off to China and other countries, where a large percentage of the time, said Shegerian, “the highest bidders are people who are averse to our homeland interests here in the United States. And they are pulling the hard drives from this material, reverse engineering our secrets and tossing the carcasses in deserts, oceans and rivers in Afghanistan, Africa, India and other parts of the world.”

The second threat to national security concerns substandard electronic components manufactured from America’s own e-waste. According to a report by the U.S. Senate Armed Services Committee, there is “overwhelming evidence of large numbers of counterfeit parts making their way into critical defense systems.” Most of the material used to make these components “is electronic waste or ‘ewaste’ shipped from the United States and the rest of the world to China,” explained the report.

Unlike the genuine components, which are manufactured from approved materials under tight supervision in clean rooms, the counterfeit parts are made from materials extracted in places like Guiyu in Guangdong Province. “Once in Guangdong, e-waste may be disassembled by hand, washed in dirty rivers and dried on city sidewalks,” said the report. The parts may then be sanded down to obliterate identifying numbers and marks, and “in a process known as ‘black topping,’ the tops of the parts may be recoated to hide sanding marks.”

Computer chips and other components manufactured under these conditions have avoided detection by even trained observers, and ended up “in military systems, including on thermal weapons sights delivered to the Army, on mission computers for the Missile Defense Agency’s Terminal High Altitude Area Defense (THAAD) missile and on military aircraft including SH-60B, AH-64 and CH-46 helicopters and the C-17, C-130J, C-27J and P-8A Poseidon.”

The solution to such counterfeiting, argues Shegerian and others, is to pass federal legislation that would ban

the export of unprocessed e-waste, a position he detailed in an op-ed in *The Wall Street Journal* titled, “Garbage Out, National Security Threat In.” The op-ed, which was co-authored by Allen Hershkowitz, long-time senior scientist at the Natural Resources Defense Council and

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co-founder and president of the Green Sports Alliance, noted that the Responsible Electronics Recycling Act (RERA), first introduced in the House in 2013, “would ban the export of non-tested, nonworking electronic devices, so that recyclers would have to prove that devices are in working condition before they could be shipped overseas for reuse or donation.” RERA, lamented Shegerian and Hershkowitz, “has been languishing in committees since the last session of Congress ended in 2014.”

There is no simple solution to the e-waste challenge. Improving U.S. recycling is part of the answer, but it will take an international effort to shut down unregulated global trade in e-waste. Exposing and eradicating the horrific conditions in places like Guiyu and Agbogbloshie can help save lives, but as the recent experience in Ghana makes all too clear, simplistic responses can do more harm than good. And while national security concerns are generating new support for federal regulation of e-waste, RERA has not even had a hearing in Congress.





Reusing and Recycling: Big Challenges, Big Opportunities

IT TAKES 100 TONS OF GOLD ORE to get 10 ounces of the precious metal, said Privahini Bradoo, CEO of BlueOak Resources, a California-based startup that launched a large “urban mining” facility in Arkansas in 2014. But BlueOak and other recyclers can extract the same amount of gold from just one ton of printed circuit boards. Silver, too, is used in circuit boards, as well as RFID tags, CDs, DVDs and plasma display screens. BlueOak notes that, in addition to the money to be made from gold and silver, an amount equal to a third of global copper mining is thrown away with e-waste every year around the world. That’s why a single recycling facility can remove \$75 million in valuable metals from e-waste annually.

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According to an article in *Forbes*, “There’s gold in them thar hills — except not nearly as much as in all the computers, cellphones and sundry electronic equipment we make and then discard.” Every year, approximately \$21 billion in gold and silver is used in the manufacturing of new electronic devices, reported VentureBeat, and that adds up to 320 tons of gold and 7.5 tons of silver. (Mercury is not a valuable metal, but it’s extremely toxic in the environment and recyclers do a great service by removing it from electronics.)

Of course, there’s not a great deal of precious metal in each device — 24 milligrams of gold in an average headset, the United Nations reports — but the sheer volume makes

it potentially lucrative. Each year, Americans abandon 152 million mobile phones, 52 million computers and 36 million monitors. Those numbers will grow. Tablet sales are expected to reach 276 million units globally in 2017 (up from 19 million in 2010). By 2017, there will be more than 2.5 billion smartphone users around the world.

But as the volume of e-waste continues to grow, the value of gold, silver and other commodities has been dropping rapidly. In 2015, a major electronics recycler, Minnesota-based Materials Processing Corp., closed down, beset by a range of problems, the worst of which was the impossibly low profit margins from the resale of the copper, nickel, gold, silver, cobalt, platinum and other materials in the devices that were being dismantled.

The commodity price issue is a major one for “urban miners” that want to recover precious metal value from used electronics. And the problem is hurting waste recovery overall. Resource Recycling reported in 2015, “America’s largest publicly traded waste management companies indicate recycled commodity pricing is causing significant losses.”

At the 2016 International Electronics Recycling Congress in Austria, commodity prices were front and center. Thierry Van Kerckhoven, global sales manager at Umicore, said low prices are causing major problems for electronics recyclers, and have forced some to shut down in both the U.S. and Europe.

“Commodity prices will continue to be under pressure in the foreseeable future,” said the conference’s keynote speaker, Steve Skurnac, president of Sims Recycling Solutions. The situation calls for creative thinking, including partnering with big electronics producers. “Recycling companies that provide additional services and work together with manufacturers,” Skurnac said, “will be able to provide valuable services within the overall supply chain.”

MANUFACTURERS PLAY KEY ROLE

Manufacturers may delight their customers by making devices ever thinner and more stylish, but recyclers see the new products as a challenge. For one thing, “There’s less precious metals like gold in components today,” said John Lingelbach, executive director of Sustainable Electronics Recycling International.

And *Wired* magazine pointed out in 2014 that, in some ways, computers before 2005 were more likely to be designed and manufactured for disassembly than they are today. The challenges today, the magazine said, include multiple colors and styles, ultra-thin profiles, cases without seams, glue in place of screws and big glass displays.

Some manufacturers produce products that are notoriously difficult to recycle, said John Shegerian, chairman and CEO of Electronic Recyclers International (ERI), which has recycled more than a billion pounds of material since 2005. But some companies are getting better at making their computers or other devices easily recyclable, he explained, a process that can include visiting ERI’s facilities to see the “pain points.”

One such company is Dell, which won the 2014 Institute for Scrap Recycling Industries “Design for Recycling Award” with its Latitude 10, Latitude E7240 notebook and XPS 10 tablet. In 2015, LG won for advanced televisions that are designed for dismantling “during every lifecycle phase.”

In addition to designing products for eventual recycling, some manufacturers — including Dell, Xerox, Samsung, LG, Panasonic and Sony — are also working closely with recyclers to take back their products when consumers no longer want them. Apple also has a recycling program, but is not very forthcoming about how it works.

According to MacWorld, “This lack of transparency makes it difficult to assess Apple’s e-waste operation.” Jim Puckett, founder of the Basel Action Network, told the magazine, “It’s very difficult to track, and you almost have to have internal knowledge of what [Apple’s] operations are. If we knew which recyclers they use, if they could tell us that, then we could find out where the [e-waste] is going.”

Choosing a recycling partner isn’t a casual process for these electronics companies. “Manufacturers are very concerned about which recycler they use,” said Scott Cassel, CEO and founder of the Product Stewardship Institute. “The last thing they want is their products being mismanaged and ending up in the media, reflecting badly back on the company.”

RETAILERS ARE HELPING

Recyclers certified by either R2 or e-Stewards (or both, as in ERI’s case) are also working with retailers that have set up take-back programs. Online super-seller Amazon has only very limited recycling programs, but Best Buy, Staples, Office Depot and Office Max have stepped up.

Amazon, which does have a mail-in recycling program for the Kindle book reader, received an “F” for its overall efforts from the Electronics TakeBack Coalition. Best Buy received a “B,” and Staples a “B+.”

Best Buy admits its program doesn’t break even, prompting British newspaper the *Guardian* to note that “Best Buy is collecting trash generated by Amazon, Walmart and other competitors” and sacrificing financially in the process. A sign of that economic pressure came in early 2016, when Best Buy said it would start charging \$25 to recycle TVs and computer monitors. Everything else, including printers, ink cartridges and computers, the company will still take back at its stores free of charge.

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According to Best Buy’s Laura Bishop, a sustainability spokesperson, “E-waste volume is rising, commodity prices are falling and global outlets for recycled glass, a key component of TVs and monitors, have dramatically declined.” She added, “Best Buy should not be the sole e-cycling provider in any given area, nor should we assume the entire cost.”

Best Buy’s program is changing, but it’s still important. Cassel said Best Buy “collects more than any other manufacturer-sponsored program, providing a convenience to consumers unsurpassed by other locations.”

Not all recycling happens at major retailers, though. A lot is done on the grassroots level, without big company involvement. For instance, at the University of Pennsylvania, a drive to collect unwanted devices that was part of ReThink Your Footprint 2015 — with six convenient drop-off stations — yielded 5.6 tons of material. “Universities should be leaders in this area, because we certainly buy our share of electronics,” said Dan Garofalo, the university’s sustainability director. After a solid waste

awareness campaign, he said, “We’re seeing incredible participation.”

REUSE: A POTENT FORCE

At ERI, the process of evaluating a phone or other device for potential reuse is done on a human scale. (Other activities, mainly the shredding process and glass cleaning and separation processes, are mechanized.) Workers test the units, repair them when needed, wipe the data and repackage them. Only if it can’t be resold does a device get stripped down to its component parts.

While individuals may no longer want their old phones, that doesn’t mean these devices have reached the end of their useful lives. A New York-based startup called Placemeter, for instance, will pay up to \$50 a month to phone owners who set their old units to provide video feeds of busy intersections. And Bemo takes your redundant Android or iOS devices and uses it as the brains of a smart thermostat and energy management center.

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The Ann Arbor, Michigan-based company Recellular, founded in 1991, showed the potential of donated cell phones by processing (and repairing) 500,000 of them a month at its peak. Half of the rebuilt phones went to domestic resellers, and half went abroad — to Africa, South America and Asia. In 2009, the company took in five million phones, and diverted 1.6 million pounds of solid waste (more than 600,000 pounds of it hazardous) from landfills.

But as with all forms of recycled electronics, the business can be cyclical and volatile. Recellular won awards, but it was hit with layoffs and then filed for bankruptcy in 2013. One problem was the increasing complexity of smartphones, which proved harder to deal with than simple call-and-text-only units.

Even without Recellular, at one time the largest player, the reuse market is thriving through resellers like Tradeups.com, SellMyCellPhones.com, EcoATM (which operates kiosks for reusable electronics), Gazelle.com, uSell.com and many others. Some major retailers such as Best Buy

also buy old phones. And, of course, like all other electronic products, they can be auctioned on eBay or sold on Craigslist.

“Cellphones are currently one of the few electronic products, if not the only one, that also have a thriving reuse market,” wrote Roland Geyer of the University of California, Santa Barbara in an academic paper, titled “The Economics of Cell Phone Reuse and Recycling.”

According to Gartner in 2015, consumers upgraded their phones every 18 to 20 months, and almost two-thirds of those replaced units are being reused. That percentage could grow, as more and more phones are privately bought and owned. “The worldwide market for refurbished phones that are sold to end users will grow to 120 million units by 2017, with an equivalent wholesale revenue of around \$14 billion,” Gartner said. “This is up from 56 million units in 2014, with an equivalent wholesale revenue of \$7 billion. Many users are attracted to used, high-end devices that they would not have been able to purchase at the original selling price.”

There are sound economic reasons for refurbishing and reselling old phones. According to Ifixit.org, recyclers get just 50 cents for the materials in a phone, but resellers average \$20 per unit.

The reuse challenge gets bigger as the waste pile grows. Anu Vedantham, director of the Weigle Information Commons at the University of Pennsylvania, delivered an e-waste talk on the campus last year, and said the issue can be daunting. “Disposal of electronics can be trickier than other forms of waste,” she explained. “At Penn, we try to donate unwanted equipment to nonprofits, but it can be complicated for privacy reasons and because of the toxic materials in the devices.”

Vedantham cites the “hype cycle” in which “new technology comes out, and everyone rushes to buy it. But expectations can lead to disillusionment, and it encourages wasteful behavior. The result is likely to be 10 old phones in the kitchen drawer, and a growing e-waste problem.” One solution from a Penn library: 35 iPads faculty can borrow for classroom use.

THE DATA CHALLENGE

One major caveat in reselling used telephones, computers and other units that store information is data security. “It’s a serious problem,” said Allen Hershkowitz, who worked on electronics recycling at the Natural Resources Defense Council. “The data is out there for people to scavenge.”

In one frightening incident from 2006, some 230 Idaho Power hard drives were sold on eBay without having

their data scrubbed. In an extraordinary effort, the company recovered 146 of them from the vendors, and got assurances from some of the eBay buyers. It's not surprising such things happen — companies often use third-party vendors to get rid of unwanted equipment without a thorough background check on how data is handled.

All Green Recycling, with clients such as Homeland Security and the FBI, pointed out, "If data destruction and security isn't handled with the care it deserves, it can lead to millions of dollars in damages and a permanently tarnished reputation."

"Everyone is security-minded now; they don't want their data breached," said Shegerian, which is why ERI wipes all devices that are being refurbished or used for parts seven to 10 times, in accordance with the U.S. Department of Defense standards. All other devices go through the company's enormous shredder, which is capable of handling over 30,000 pounds of e-waste per hour. And every device is tracked, using proprietary ERI software,

throughout the recycling process, so that customers such as Best Buy, Staples and Dell can track their devices to confirm a clean wipe.

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With so many of the devices we use going literally to waste, ERI's Shegerian pointed out, "The opportunity for recyclers is massive." But given today's low commodity prices, changing product design and data concerns, he added, "It's also very labor-intensive and a very hard business to succeed in."





Electronics Recycling: Competing Certifications Create Confusion

THE CASE FOR ELECTRONIC RECYCLING HAS NEVER BEEN STRONGER, and the excuses for not doing it have never been thinner. “Recycling electronics is becoming easier by the day,” reports *The New York Times*. But ease of recycling is not the only concern of companies eager to ensure their growing piles of e-waste don’t end up in a landfill or — maybe even worse — dismantled under horrific conditions overseas.

Complicating their efforts is the fact that there are two respected (and competing) standards that recyclers are asked to use, and both claim the high ground. Both also require recyclers to adhere to a strict code of responsible handling. The consensus is that one, Basel Action Network’s e-Stewards, is more stringent in handling waste, while the other, Sustainable Electronics Recycling International’s R2, is more practical and easier to implement. R2 also has certified more recyclers.

A little history is in order. Developed under the auspices of the United Nations, an international agreement was adopted in Basel, Switzerland, in 1989. Known as the Basel Convention on the Control of Transboundary Movements of Hazardous Wastes and their Disposal, it was ratified by 113 countries over the next eight years. Today, 180 countries have signed on.

An amendment to the Basel Convention (the so-called Ban Amendment) imposed a blanket ban on hazardous and e-waste exports from 30 industrial countries to the developing world, effective in 1998, but many western governments said it was not legally binding because it had not been officially ratified by the Basel Convention. To date, just 12 more countries need to ratify the Ban Amendment for it to become part of the Basel Convention and enter into force.

Then, in 2006, a world conference on the Basel Convention was held in Nairobi. Negotiators realized that electronic products were increasingly being sent to the developing world for recycling, and the U.N. said dismantlement was “often not managed in an environmentally sound manner, thus posing a serious threat to both human health and the environment.” Out of that process, the Basel Convention developed technical guidelines (released in 2012) on handling the hazardous waste and precious metals in e-waste. Again, there was substantial pushback.

The United States is not a signatory to the Basel Convention, and as noted elsewhere in this report, there is no law regulating e-waste at the national level. But to meet the needs of consumers, retailers and manufacturers that want to ensure their e-waste is handled appropriately, the two standards were developed. The Responsible Recycling or R2 certification says its standard is “fully consistent” with the Basel Convention, and “in many cases mandates practices that exceed current international legal requirements.”

The rival Basel Action Network or BAN certification is closely allied with and promotes the Basel Ban Amendment Ratifications, and its basic premise is that they are in effect and binding.

R2: SETTING THE STANDARD

The R2 protocol emerged from an open, consensus-based, multi-stakeholder process organized by the EPA. The so-called R2 Technical Advisory Committee (TAC) released the standard in 2013. It’s administered by Sustainable Electronics Recycling International (SERI), which “works to create a world where electronic products are repaired and recycled in a way that promotes resource preservation,

the health and safety of the natural environment and communities around the world, and worker safety.”

Currently, more than 500 recyclers around the world are certified to meet the R2 standard, with participation in India, Thailand, Hong Kong, Brazil and Costa Rica, among others.

R2 prioritizes reuse and recovery, including of e-waste that is in less-than-optimal condition. R2 Solutions says fully functional equipment that can be used out of the box “is clearly outside the scope of the Basel Convention.” An R2 recycler, the rules state, “shall take all practical steps to direct tested equipment and components to reuse and resale, and to direct equipment capable of repair to qualified refurbishers, unless a customer directs otherwise.” Equipment can’t go to incinerators, energy recovery or landfills “unless no reuse or recycling options are viable.”

According to John Lingelbach, executive director of SERI, “R2 instructs waste shippers to comply with all laws on exporting and importing e-waste. But under R2, recyclers don’t have to act as if the Basel Convention — which has not been implemented by many countries — were actually in effect. Companies can ship e-waste to countries that have not implemented the Basel agreement, with conditions: The facility has to be safe.”

E-STEWARDS: SETTING A HIGH BAR

The nonprofit Basel Action Network (BAN), based in Seattle, “works to prevent the globalization of the toxic chemical crisis.” It launched e-Stewards as a pledge program in 2003, and cites more than 40 qualified recyclers, with 100 locations, across the U.S. and Canada.

E-Stewards’ principles include:

- no disposal in landfills or incinerators;
- no prison labor;
- no export of toxics to poor communities.

The other provisions are self-explanatory, but the reference to prison labor requires further explanation. It concerns the UNICOR program, launched in 1994 by the U.S.-based Federal Prison Industries (FPI), which uses inmates to dismantle e-waste behind bars. According to FPI, the program generated \$128,120 in 2013 sales, and operated at a net loss.

BAN participated in the EPA’s R2 process, but broke away from it after two-and-a-half years. The emerging R2 standard, BAN said at the time, “would violate laws in importing countries, as well as to allow toxic substances in solid waste disposal facilities.” In 2006, after certification

experts were brought in from the recycling, health, safety and asset management sectors, BAN’s pledge program became an independently audited certification program that competes with R2.

E-Stewards promotes reuse, as does R2, but it focuses on equipment that is fully functional. And it has high-profile support, including Greenpeace, NRDC, the Electronics TakeBack Coalition and such major companies as Staples, Alcoa, Costco, Samsung, LG, Nvidia, Wells Fargo and Bank of America.

“We stop the export of illegal hazardous e-waste to developing nations and create a safe, green, and just world through sharing and using principled and practical standards for electronics recycling and reuse,” BAN said.

WHICH STANDARD?

In 2011, ERI became the first e-recycler to be both R2 and E-Stewards certified at all its operating locations. Today, says Scott Cassel, chief executive officer and founder of the Product Stewardship Institute, “Most recyclers will have both R2 and e-Stewards certification.” That approach certainly guarantees maximum confidence from customers.

But consumers are understandably perplexed by the competing standards, which have many similarities and fairly subtle differences. Things got somewhat more confusing in 2012 when BAN said that henceforth, the e-Stewards standard would include all the provisions of R2, as well as ISO 14001, offering “three electronic recycling certifications for the price of one.” According to Jim Puckett, BAN’s executive director, “By itself, R2 is inadequate to the task of ensuring a high degree of responsible recycling.”

SERI responded to that by asserting that R2 remained “an independent standard administered by R2 Solutions,” and that BAN’s action “does not make R2 and this other standard equivalent or interchangeable.”

Lingelbach also claimed critics are wrong when they say R2 is weaker than e-Stewards. “In many respects, particularly with respect to transport and movement of end-of-life electronic materials, R2 is stronger in outright requiring of air monitoring,” he said.

E-Stewards has seen some high-profile defections. In 2015, electronics giant Best Buy stopped requiring its recyclers be certified by the standard, noting that it was losing money on the program. “We absolutely sympathize with Best Buy’s need to at least break even on a voluntary program that benefits the public,” BAN said. “However, lessening environmental and social responsibility to cut costs isn’t the way to go.”

BAN now recommends that consumers take their unwanted electronics to Staples, which developed the first computer take-back program in the U.S. (in 2004), accepts a wide variety of products without cost (whether they were bought at the retailer or not) and uses only e-Stewards-certified recyclers.

Another defector is Sims Recycling Solutions (SRS), which had nine facilities certified by e-Stewards. “The e-Stewards certification isn’t providing any real material business value to Sims in the U.S.,” Steve Skurnac, SRS president, told *Resource Recycling* in 2015. “I think recyclers have always been interested in it, but the folks that use recyclers, whether they’re corporations or municipalities, don’t see it as a super-high priority.”

BAN’s Puckett said he “vehemently disagrees” that e-Stewards certification is not worth the cost.

A SINGLE PATH?

For outside observers, it would be a plus if there was a single go-to electronic recycling standard. “That would be great,” said Allen Hershkowitz, who was deeply involved in e-waste issues during his tenure at the Natural Resources Defense Council (he now heads the Green Sports Alliance).

Hershkowitz noted that e-Stewards “is the only protocol that complies with international law,” and is thus recommended by GSA to sports teams that want maximum protection against embarrassing waste disposal episodes. But he also said R2 has far more certified recyclers “because it’s an environmentally better approach. Companies feel it’s doable, and they can meet the standards.”





How U.S. Laws Do (and Don't) Support E-Recycling and Reuse

THERE IS NO U.S. FEDERAL LAW THAT REQUIRES THE RECYCLING OF ELECTRONIC WASTE or prohibits it from being exported to developing countries. Some in Congress have tried to pass a bill that would make the overseas dumping of toxic e-waste illegal, but the **Responsible Electronics Recycling Act (RERA)** has been stuck in a House subcommittee for more than two years.

An existing law, the federal Resource Conservation and Recovery Act (RCRA) does cover some toxic electronic waste, but according to the Electronics TakeBack Coalition (ETBC), virtually all electronic components that are being exported for recycling are exempted. The only exception, as of December 26, 2014, is the federal CRT (cathode-ray tube) Rule, which led to the much-publicized prosecution of a single Michigan e-waste trader in March 2015.

That's it, legislatively, at the federal level. The EPA facilitated discussions between 2001 and 2003 to try to reach consensus on what could be a national e-waste law, said Scott Cassel, chief executive officer and founder of the Product Stewardship Institute, but without success.

"By the end of that process, there were a number of policy options on the table," according to Cassel, "but the electronics industry could not come to an internal agreement on what it wanted. That resulted in no national agreement, and the issue was thrown back to the states to develop their own solutions. But no one state model emerged. And manufacturers are still not on the same page as an industry because of competing interests."

WHAT'S HAPPENING AT THE STATE LEVEL

The first state to pass an e-recycling law was California, in 2003. Since then, 27 other states and the District of Columbia have followed suit. (Massachusetts legislators have tried to pass a statewide e-recycling law for several

years without success; the state does ban e-waste from landfills). That leaves 22 states with no statewide laws, although in many places, take-back programs are offered by private companies, nonprofits and/or local governments (New York was the first major city to set up its own e-waste collection program and to ban electronics from garbage cans).

While the California law is financed by an explicit fee, 23 other states require manufacturers to cover the costs involved in collecting and recycling their products to some degree, according to ETBC. It's generally assumed that such extended producer responsibility (EPR) laws will not only cover costs, but also give manufacturers an incentive to design greener products, thereby reducing the recycling costs they have to cover.

There is no U.S. federal law that requires the recycling of electronic waste or prohibits it from being exported to developing countries.

But that's in theory. In practice, EPR laws often assign responsibility for e-waste financing to "a whole class of manufacturers," rather than to individual companies, argues Josh Lepawsky of Memorial University in Canada.

"Since all producers in such a system share responsibility for their own and each other's end-of-life products, the incentive for any single producer to make design changes that would reduce the costs of recycling or reuse are diluted." According to Walter Alcorn, a vice president for the environment at the Consumer Electronics Association (CEA), "Better design for the environment because of take-back mandates is not happening."

LABORATORIES FOR DEMOCRACY

State laws also fall short in other ways, but they are serving as the “laboratories of democracy” that Supreme Court Justice Louis Brandeis envisioned in 1932. Among the “experiments” being conducted:

Convenience vs. performance mandates — five states (Connecticut, Maine, Oregon, Vermont and Washington) have laws that require manufacturers to provide enough broadly distributed collection sites to meet demand (i.e., to make it convenient for all state residents to properly dispose of their electronics). To meet this requirement, the state generally hires a contractor to manage a statewide collection system paid for by the manufacturers, so in practice, the convenience mandate also represents a centralized approach.

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The remaining EPR states use a performance, rather than a convenience standard, setting collection targets generally based on weight. The goal is often stated as a percentage of the previous year’s sales or average sales of the past few years. If manufacturers fail to meet minimum targets, they may have to pay an additional fee.

Based on the amounts of e-waste collected per capita (as calculated by ETBC), states using the convenience method are outperforming those employing the target-setting approach. According to Resa Dimino, senior advisor for policy and programs at the Product Stewardship Institute, a major reason is that electronic devices have been getting lighter each year, and as the weight of sold electronics declines, so does the targeted weight of materials that manufacturers have to collect and recycle.

But the products people are turning in tend to be older and heavier, so manufacturers are hitting targets well before meeting demand. Once they’ve hit their mandated goal, manufacturers are no longer obligated to fund recycling efforts. The resulting lack of funding, said Dimino, has reduced access to collection sites in some performance-standard states.

One possible answer to the performance vs. convenience approach that New York state is currently trying is to combine the two kinds of requirements. The experiment is ongoing.

The CRT problem: Among the heaviest materials showing up at recycling centers are CRT monitors and TVs, which can represent a significant share of the e-waste stream. These dinosaurs from the pre-digital age pose a particular burden, not just because they contain lead, but also because the market for recovered CRT glass has virtually disappeared with the advent of flat-screen technology. Today, said Dimino, there is only one company in India that recycles CRT glass, and the cost of CRT management has doubled as a result.

Dimino explained that manufacturers initially thought the CRT problem would pass through the system in a year or two, but studies have found that people are hanging on to CRT monitors and TVs, using them as coffee tables or giving them to their kids. Dimino estimated that it will be six or seven years before manufacturers see a drop-off in CRTs. Based on the minimal decline in CRT recycling that ERI has seen over the past 11 years, it will be a minimum of 15 years before the CRT problem eases significantly, said John Shegerian, chairman and CEO of Electronic Recyclers International (ERI).

However states deal with the CRT problem, the issue points to a larger concern for any law governing e-waste: E-recycling laws have to allow for the fast-changing conditions of the electronics marketplace.

FIVE MORE LESSONS FROM THE STATES

As states continue to struggle with e-waste legislation, they also continue to generate important lessons for future lawmakers. ETBC has compiled a list of lessons learned by studying the outcome of the various state programs. Among them are:

- 1. Make requirements specific.** You don’t collect what you don’t legally require. Texas, among others, did not specify levels of performance, and nearly half of the 78 computer companies in the state collected no e-waste at all, while “a small San Antonio company called Altex collected 92% of the volume.”
- 2. Encourage rural collection.** It costs less to collect e-waste in dense urban areas than in rural ones, so laws should either require rural collection specifically or incentivize it, as Minnesota has done.
- 3. Ban e-waste from landfills.** States that implement a landfill ban on e-waste see recycling volumes climb when the bans go into effect.
- 4. Don’t let recycling discourage reuse.** Laws that reward recycling more than reuse can inadvertently discourage the latter. In California, recyclers are not reimbursed for reuse, “so reusable units are mostly diverted for recycling,” said the ETBC.

5. Make the scope of collection as broad as possible.

People want to bring in all the e-waste they have and are more likely to use programs that accept it all.

NO SUBSTITUTE FOR A FEDERAL LAW

States are doing what they can to deal with e-waste in the absence of federal legislation. But there are some measures only a federal statute can address. State laws often reference standards and international agreements forbidding the export of toxic e-waste to developing countries, for instance, but states lack jurisdiction over the matter. And the complicated patchwork of varying state laws makes it far more difficult and expensive for manufacturers to be good corporate citizens than would a single, coherent federal law.

Finally, the differing state requirements provide no incentive for manufacturers to focus on greening their products, because no one state has the market heft needed to influence global companies. As Lepawsky notes,

the European Union represents such a large market that its Restriction of Hazardous Substances Directive has “created a de facto global standard for electronics manufacturing, because it is more economical for manufacturers to produce all their products that are also

Studies have found that people are hanging on to CRT monitors and TVs, using them as coffee tables or giving them to their kids.

sold in the EU to that jurisdiction’s material specifications, rather than different specifications for different markets.”

Federal legislation could jump-start dramatic progress in the reduction, reuse and recycling of e-waste.



Special Report

Recycling Electronic Waste

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