

Computer Refurbishing: Environmentally Reducing the Digital Divide

by Howard Fosdick

EDITOR'S SUMMARY

The two-to-five year lifespan of a typical computer leads to many machines being unnecessarily disposed of, while over one in four Americans has no access to a computer. The troubling combination of electronic waste and digital deprivation can be resolved through computer refurbishing. Distinct from recycling in which computers are rendered unusable, computer refurbishing extends the usable life of donated computers, avoiding the consumption of additional natural resources. Electronics trade-in or recycling programs often ship machines overseas, leading to environmental pollution and harming workers' health. Refurbishers determine which machines are suitable for refurbishing or teardown, securely destroy any residual data and often install free and open source software. Consumers can help narrow the digital divide by turning to computer refurbishers such as Free Geek, ultimately helping to broaden computer access in an environmentally sustainable manner.

KEYWORDS

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In modern America those who don't routinely use computers and the Internet are at a severe disadvantage. Yet a government report based on 2010 census data reveals that 28% of Americans don't normally plug in [1]. One reason is that many lack a capable computer device (desktop, laptop, tablet or smartphone).

Meanwhile, the lifespan of the typical computer ranges between two to five years. Many are discarded before the end of their useful lives due to minor software or hardware problems [2]. The majority are *not* properly disposed of and end up in open-air incinerators or landfills. Electronics contain many toxins, including mercury, arsenic, cadmium, lead, phosphorus, BFRs, beryllium and more. E-waste disposal is a vital environmental challenge, and its status in the United States today is little short of scandalous [3].

Digital deprivation. Rampant e-waste. Two different problems. Yet one solution addresses both: computer refurbishing.

Computer refurbishing takes donated computers, fixes them up and gets them to people who otherwise may not own a computer. It addresses the problem of digital access for underserved populations by extending computer lifespans. It even reduces the rate at which we consume natural resources, since reusing computers ameliorates the need to manufacture new ones. It takes a lot of chemicals and fossil fuels to manufacture a computer, up to 10 times the product's weight [4], which explains why your laptop, measured on a per pound basis, costs more than your car or any appliance you own.

This paper overviews computer refurbishing, its benefits and its limitations. It describes how charitable organizations serve the digitally disadvantaged while simultaneously tackling the critical issue of e-waste disposal.

How Refurbishing Works

Most computer refurbishing is done by charitable organizations. Here's how one volunteer group, Free Geek Chicago, does it. FGC is one of over a dozen Free Geek locations in the United States and Canada.

Individuals and companies donate used computers to Free Geek on a tax-deductible basis. Table 1 summarizes the desktops that come in the door.

TABLE 1. Processors received by Free Geek. All numbers are approximate because computers vary by manufacturer. *Typical memory* is what donated computers usually come in with. *Maximum memory* is their maximum configurable memory. Sources: [5] and personal experience.

Processor	Produced	Processor Speed	Typical Memory	Maximum Memory
Pentium IIs and older	Before 2000	Less than 450 mhz	Less than 64 M	Less than 256 M
Pentium III	1999 - 2003	450 mhz to 1.4 ghz	128 to 256 M	512 M to 1 G
Pentium IV	2000 - 2008	1.3 to 3.8 ghz	256 M to 1 G	2 to 4 G
Early dual processors (Pentium D, AMD 64 X2, Pentium Dual Core)	2005 on	1.3 ghz times 2 to over 3 ghz times 2	1 or 2 G	4 G or more

Computers need more than a 1-ghz processor to run web video smoothly. With sufficient memory and suitable software such a computer can perform almost any common consumer task [6]. So a 10-year-old computer can do anything a new one can – if it's properly configured.

Charities must decide which machines are worth refurbishing versus what can only be recycled. FGC selects Pentium IVs or better for refurbishing. Standards are a bit lower for laptops, as fewer laptop donations come in and they are typically not as powerful. Plus there is a huge demand for them. Many people are grateful to obtain even a Pentium III laptop.

The most desirable computer donations have single hardware problems that prompt owners to replace them. Perhaps the disk drive failed or memory has become unreliable. Laptops often overheat. FGC easily diagnoses and fixes these minor hardware problems, yielding powerful machines for reuse. Many people abandon perfectly good machines due to software problems. Windows tends to slow down with age and most consumers don't know they need to tune it up (just like you would your car [7]). Or Windows may

develop registry problems or get hit by malware or viruses. FGC fixes all software problems quickly and easily. Just wipe the disk and install a fresh operating system. About one-quarter to one-third of our donations are perfectly usable computers that have developed these easily fixed issues.

Here's how FGC processes donations:

- As donations come in the door, FGC assesses their power. Older systems are consigned to teardown, where they are disassembled into their components. Some components can be saved and reused even from these systems. They are removed and will be built into refurbished systems. Or they are sold back into the community for rent money. Parts that are obsolete or broken are segregated by material – a precondition to proper recycling – and then are environmentally recycled. For refurbished systems all components are thoroughly tested. Broken parts are fixed or are removed and replaced.
- Disk data is always securely destroyed by overwriting the entire disk using a tool named Darik's Boot and Nuke [8]. DBAN meets U.S. government standards for data destruction. If the disk doesn't work it is physically destroyed. Windows commands for deleting or erasing files from a disk drive do not make that data inaccessible. Nor does reformatting the disk! Thus there is a big business in third world countries in buying disk drives and recovering their "deleted" data for the purposes of identify theft. Your used drive sells for £20UK in Nigeria, for example [9]. You can't retain the Windows operating system and the installed applications while thoroughly destroying user data on that disk [7]. The only sure method for destroying user data overwrites the entire drive, wiping the OS, applications and all data.

Refurbishing requires labor. At Free Geek, the computer recipients themselves supply this labor (along with expert volunteers). A free computer recipient starts in teardown. Here he learns about computer components and how they are connected into a working system. Eventually he moves to component testing and fixes. After several days he is ready to assemble his own computer. Thus the recipients of refurbished machines provide free labor. FGC educates people about computers while they build their own free machines.

Refurbishing Vs. Recycling

The Free Geek model highlights the key distinction between *refurbishing* and *recycling*. Refurbishing means reusing a computer. Recycling means destroying the computer and then environmentally recycling its constituent materials.

Refurbishing is preferable to recycling. This sequence describes the ideal lifecycle of the typical computer:

1. Purchase the new computer
2. After several years of use, donate the computer for refurbishing
3. Recycle the computer only when it is truly obsolete or broken beyond repair

Unfortunately the typical progression is like this:

1. Purchase the new computer
2. After several years of use, recycle the computer – whether or not it’s obsolete or broken beyond repair
- or
2. After several years of use, throw the computer into the trash – whether or not it’s obsolete or broken beyond repair

Retail store, computer vendor and local recycling trade-in or recycling programs rarely refurbish! They simply recycle because refurbishing requires labor. It costs money. Refurbished machines cannot be sold at high enough prices to cover these costs. Charitable organizations like Free Geek don’t face this quandary because they use volunteer labor.

Many recyclers address their labor costs by shipping used electronics overseas. There overseas operators either refurbish or recycle the equipment. Often the goal is to avoid American environmental and labor health and safety laws. Thus has evolved what is termed the *toxic trade*, by which used electronics go overseas for dismantling in unsafe conditions or for open-air incineration [3]. (Burning a computer is the cheapest way to separate valuable metals from the worthless plastics. It’s also highly pollutive.)

Environmentalists and labor activists argue that the United States should ban overseas shipping of used electronics [10]. Some vendors and for-profit recyclers respond that overseas companies provide much needed jobs and operate within local environmental and safety standards [11]. In actuality,

no one really knows what happens to most exported equipment. There is no oversight. What we do know is that overseas abuses are routine and have been documented by many sources including *60 Minutes*, NPR, *BBC World News*, PBS *Frontline*, *Huffingtonpost* and CNN [12]. But it’s not a simple situation. Some exports do provide jobs and computers for developing nations.

Free Software – The Secret Sauce

Free and open source software (FOSS) presents an alternative to Microsoft Windows and Office. While Windows and Office dominate on desktops and laptops, FOSS dominates on tablets, e-book readers and smartphones.

Refurbishers divide between those who install Windows and those who favor FOSS and Linux. Windows requires that refurbishers license software through Microsoft licensing agreements. Microsoft has two programs specifically for refurbishers that sell reduced-fee licenses to organizations that adhere to their program requirements [13]. Microsoft also financially contributes to TechSoup Global, a non-profit that promotes commercial software for refurbishing [14].

FOSS and Linux are the better choice for these reasons:

1. **Cost.** FOSS is free. It is fully competitive with commercial software. Why would charities spend on software when they don’t have to?
2. **Runs on Older Equipment.** Microsoft’s business plan is one of planned obsolescence, and therefore it designs its software to run only on the latest hardware. Refurbished machines can’t run current Microsoft software. For example, a refurbished Pentium IV with 512 M memory can only run Windows XP, which has long been made obsolete by Vista and Windows 7. That same computer will run almost any current Linux offering [6].
3. **Performance.** Linux makes more efficient use of aging hardware than Windows. One reason is that Linux is not burdened with the overhead required by Windows’ malware scanners. Another is that it is not designed for planned obsolescence. There are even Linux distributions (offerings) that are specifically designed for older computers.
4. **Free Applications.** FOSS is more than just a free operating system. Linux distributions like Ubuntu offer over 10,000 free applications.

Microsoft charges for its applications – such as Office – over and above what Windows itself costs.

- 5. Flexibility.** FOSS lacks activation and other restrictive anti-piracy technologies embedded in Microsoft products. These restrictions get in the way during refurbishing work.

At Free Geek, Linux and FOSS are our “secret sauce.” Without them we could not hope to achieve what we do.

Reducing the Digital Divide

The United States now ranks 94th in the world among nations in family income equality. This continues our 20-year descent in the rankings and puts us just below Cameroon and Cote d’Ivoire [15]. There is no question that a key contributor to growing inequality in our country is uneven digital access [1].

You can reduce the digital divide by donating your used computer to a suitable refurbisher. Donations from colleges, libraries and schools are especially welcome. For a list of refurbishers, please see Table 2. To ensure you donate to the right place, follow these simple rules:

- 1. Select a refurbisher over a recycler.** This ensures your computer is reused if possible and only recycled at its true end of life.
- 2. Ask the refurbisher how old a machine they will reuse.** Most Windows refurbishers only reuse machines up to about five years old [16]. Most Linux refurbishers reuse computers made since 2000. Linux groups reuse many machines; Windows refurbishers will only recycle.
- 3. Ask if they perform the work in the United States.** Organizations that ship systems overseas often misrepresent the conditions under which the work is performed. Since there is no way to verify any claims, the overseas trade is now rife with scams. To prevent your good deed from being turned into abuse by a fake recycler, pick an organization that performs all work in the United States.
- 4. Ask how they securely erase your disk data.** And if they erase the entire disk. A good refurbisher overwrites the entire drive using a tool that meets government security specifications, such as DBAN. Don’t trust any guarantees given by an export recycler. They don’t control what happens to your computer once it leaves the country.

- 5. Ask if they train recipients.** An effective refurbisher provides free basic computer training to all recipients. The digitally underserved need computer education as much as they need hardware.

Today, many well-meaning people face the complexities of computer donation without these rules of thumb. They donate their computers to recyclers with the best of intentions, but unknowingly contribute to overseas pollution or hurt the health of workers. Or their computers are destroyed for recycling when they could have been reused. This devastates the secondary market from which most low-income people acquire computers. Thus far neither legislation nor voluntary efforts have rectified this situation. You can make a difference by making the right personal choices. ■

Resources on next page

TABLE 2. Refurbisher information

Free Geek	Linux refurbisher. Find locations here – http://en.wikipedia.org/wiki/Free_geek#Locations
Free Geek Chicago	Please donate to us if you’re in the Chicago area – http://freegeekchicago.org/
Electronics TakeBack Coalition	Excellent summary material on refurbishing, recycling, etc – www.electronicstakeback.com/home/
Earth911	Another excellent summary web site _ http://earth911.com/recycling/electronics/
Basel Action Network (BAN)	Works to stop exports of used electronics – www.ban.org/ . Generally opposes WR3A
World Reuse, Repair, and Recycling Association (WR3A)	Business consortium supporting development of Fair Trade standards for international electronics recycling – www.wr3a.org/ . Generally opposes BAN
e-Stewards	Certification program for environmentally correct recyclers – http://e-stewards.org/
Computer Aid International	Major U.K.-based refurbisher for developing nations – www.computeraid.org/
TechSoup Global	Vendor-supported non-profit that promotes commercial software and Windows-based refurbishing – http://home.techsoup.org/pages/default.aspx
Microsoft refurbishing programs	Microsoft’s two refurbisher programs – www.microsoft.com/refurbishedpcs/Programs.htm

Resources Mentioned in the Article

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- [11] *World Reuse, Repair, and Recycling Association (WR3A)*: www.wr3a.org/. WR3A is a business consortium supporting development of Fair Trade standards for international electronics recycling.
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NPR: www.npr.org/programs/watc/features/2002/apr/computers/index.html. *BBC World News*: <http://news.bbc.co.uk/2/hi/africa/7543489.stm>.
PBS Frontline: www.pbs.org/frontlineworld/stories/ghana804/. *Huffingtonpost*: www.huffingtonpost.com/2008/11/10/toxic-discarded-electroni_n_142594.html.
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