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Islands in the Wastestream

BASELINE STUDY OF NONCOMMERCIAL COMPUTER
REUSE IN THE UNITED STATES

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A COMPUMENTOR REPORT BY JIM LYNCH

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Executive Summary

The United States faces a unique challenge and opportunity regarding the disposal of obsolete computer equipment. On the one hand, three-quarters of all computers sold in the United States remain stockpiled in businesses and homes.¹ On the other, thousands of schools, nonprofits, and low-income families could greatly benefit from access to this resource. Unfortunately, no direct nationally based distribution system links this supply with this demand.

CompuMentor's Baseline Study of Noncommercial Computer Reuse in the United States examines the computer reuse field to establish the quantity, quality, and overall effectiveness of computer reuse taking place in the Bay Area and, to some degree, the rest of the country. The study also profiles how businesses fit into the field of charitable computer reuse.

To the best of our knowledge, definition of the noncommercial computer reuse field has not been completed anywhere else in the country to the extent reflected in this study. Our findings bring new information and analysis to those interested in environmental and digital divide philanthropy.

STUDY HIGHLIGHTS

- **Approximately 40% of US families do not have Internet-capable computers.**²
- **Approximately 30%-40% of nonprofit workers do not have Pentium-level computers to perform their work.**³
- **CompuMentor research estimates public school need for computers at 140,000 in the Bay Area and 9 million nationally.** This need has been dramatically affected by recent state and local budget cuts.
- **Demand for low- or no-cost computers is high and currently largely unmet in the San Francisco Bay Area and the US.**
- **Noncommercial computer reuse demonstrates increasing potential to fulfill these needs in the US.**
- **US corporations are interested in donating computers, but primarily to meet philanthropic or corporate citizenship concerns.** Currently, no uniform or substantial tax deduction benefit exists for US businesses to donate fully depreciated computers to charities and schools.
- **Computers for Schools Canada is a functioning proof-of-concept for non-commercial computer reuse,** already supplying 25% of computers in Canadian schools, and also supplying computers to Canadian nonprofits. Canada is far ahead of the US in this field.
- **From an environmental standpoint, it is preferable to reuse computers an extra two or three years than to recycle their components.** Over each computer's life cycle, reselling or upgrading computers saves 5 to 20 times more energy than recycling.

AN INTRODUCTION TO NONCOMMERCIAL COMPUTER REFURBISHING

The noncommercial computer refurbishing field is a small part of the overall computer recycling industry, under 2% in the US. It is comprised of noncommercial organizations⁴ that refurbish discarded computer equipment to help achieve a broader social mission, such as reducing the environmental impact of e-waste or helping individuals and organizations cross the digital divide.

KEY CHARACTERISTICS

Key characteristics of the noncommercial computer refurbishing field are listed below:

- **Businesses and government supply a majority of computer donations to noncommercial refurbishers.** Donations from individuals account for a smaller portion of the donation stream.
- **60% of US noncommercial refurbishers surveyed by CompuMentor do not charge fees for the refurbished computer equipment they provide.**
- **Noncommercial refurbishers typically employ two or three paid staff but rely heavily on volunteers, with an average of 30 or 40 volunteers each.**
- **Most of the noncommercial refurbishers surveyed report that they expect their capacity to double in the next three years.**
- **66% of surveyed noncommercial refurbishers report that they can properly clean data from donated computers as part of their process, but only the larger refurbishers report doing so on a routine basis.**
- **CRT monitors are the biggest e-waste cost factor for noncommercial computer refurbishers.** In the San Francisco Bay Area, most refurbishers charge at least \$10 to cover CRT monitor disposal costs. In the rest of the country, only 25% of refurbishers charge donors for accepting monitors.
- **Original equipment manufacturers have played a limited role in the noncommercial computer reuse field** even though noncommercial refurbishers would like to work more closely with them.
- **Noncommercial refurbishers engage in minimal information sharing regarding technical issues but do not share an established set of standards.**
- **Private foundation and government grants are currently inadequate to support the development of the noncommercial computer reuse field.**

LOW SUPPLY, HIGH DEMAND

Largely due to low visibility and the lack of a large-scale donation distribution system, the supply of computers via noncommercial refurbishers is relatively small at an estimated 23,000 computers per year in the Bay Area and 200,000 computers per year in the US. According to a Catalyst Alliance/UC Berkeley Haas School of Business study, the San Francisco Bay Area business community is very interested in donating computers. However, they are unclear on how to donate equipment, ensure data security, and recover costs (or at least avoid disposal costs).

In contrast to these low supply levels, demand for good low- or no-cost working computers is significant, estimated at a half million in the Bay Area and 28 million in the US.

ESTIMATED DEMAND FOR REFURBISHED COMPUTERS

	SAN FRANCISCO BAY AREA	UNITED STATES
Nonprofits	96,000	4.2 million
Low-income families	160,000	10.5 million
Microenterprises	135,000	5 million
Schools	140,000	9 million
TOTAL NEED	531,000	28.7 MILLION

** Microenterprises are small, often family-owned businesses capitalized at under \$25,000 per year. They currently account for approximately 16% of Bay Area and US employment.*

The noncommercial computer reuse field is not meeting this demand. Several factors have hampered the growth of this field, but the high cost of operating systems arguably has been the most significant stumbling block. This cost factor alone has caused noncommercial refurbishers to limit their capacity to the number of operating systems they could afford, thus keeping programs small and marginal.

IMPORTANT DEVELOPMENTS: MAR AND LINUX/OPEN SOURCE

CompuMentor's March 2003 survey of noncommercial refurbishers found that most computers are donated either with hard drives wiped or without the operating systems, media, and documentation sufficient to reuse the software. Operating systems supply the device drivers required to run the graphics card, modem, network card, sound card, and other essential parts of the computer.

- **THE MAR PROGRAM** Launched in December 2002 as an initiative of Microsoft and CompuMentor, the Microsoft Authorized Refurbisher (MAR) Program has greatly remedied the operating system problem and increased capacity in the field by approximately 30% among refurbishers. Schools are the main recipients of MAR computers, receiving 50% of the computers that are processed through the program. Nonprofits receive 27% and low-income families and individuals receive 23% of MAR computers. The average cost of these computers to recipients is \$49, although 55% of MAR refurbishers supply them for free.

Not surprisingly, MAR has quickly become integral to the noncommercial refurbishing movement and has provided a central point of reference for the field.

- **LINUX/OPEN SOURCE** The Linux/Open Source movement is another area of interest among noncommercial refurbishers. Many noncommercial computer refurbishers use Open Office or 602 PC Suite on their computers, if for no other reason than the MAR program does not yet supply an office suite. Several people in the Linux/Open Source refurbishing community are also interested in building Linux-based "thin client" computer networks in which a server runs the programs and the PCs simply display the video and accept keyboard and mouse input. Because the server runs a version of Linux, the software is free, virus issues are minimal, and maintenance time is substantially reduced. Only the server needs to be a fairly current computer, while the clients can be low-end Pentium Is. Companies like Academic Computing Environments and Symbio Technologies in New York are promoting thin client Linux solutions. Efforts to develop Linux thin client solutions have mostly targeted schools, but there is also active interest among community technology centers.

PROOF-OF-CONCEPT: COMPUTERS FOR SCHOOLS CANADA

Computers for Schools Canada is a large and successful nationwide noncommercial computer reuse program that now furnishes 25% of the computers supplied to Canadian schools. Although largely unknown in the US, the program is a fully developed proof-of-concept directly applicable to low- and no-cost computer needs within the US. Of course, excellent refurbishing programs do operate in the US—such as Per Scholas in New York, Computers for Schools in Chicago and Philadelphia, and OTX West in Oakland—but the US does not have a coordinated, nationwide means of supplying donated computers to schools, nonprofits, and low-income families such as exemplified by Computers for Schools Canada.

DEVELOPING THE FIELD

CompuMentor is now undertaking a comprehensive body of research, coordination, and hands-on projects to deepen public knowledge of computer reuse and refurbishing. Much of this work is guided by nine factors that CompuMentor has determined to be critical to building the field's capacity:

- **Increase the computer reuse and refurbishing field's visibility.**
- **Develop the community of noncommercial computer refurbishers for information sharing.**
- **Expand the MAR program to include other needed resources for noncommercial computer refurbishers.**
- **Create a standards or accreditation body that sets practical warranty, fail rate, and data removal standards.**
- **Encourage the creation of large-scale donation or intermediary mechanisms to distribute computers to refurbishers to make corporate donations much more cost effective.** This approach also answers the need that refurbishers have for a more consistent supply of useful donations.
- **Provide noncommercial computer reuse and refurbisher representation to help the National Electronic Product Stewardship Initiative (NEPSI) create a national computer recycling system.**
- **Identify and develop downstream e-waste disposal options to better close the loop between computer refurbishers and recyclers.**
- **Foster the transfer of knowledge and resources around computer refurbishing to developing countries.** While a significant portion of the US population still does not have access to computers, the need is much deeper in Africa, Latin America, and Asia. A number of projects are beginning to work with developing countries, where typically well under 10% of the population has access to computers. Considerable potential exists to bring the reuse and refurbishing infrastructure developed in the US to the benefit of other countries.
- **Advocate for federal legislation to amend Section 170 of the US Federal Income Tax Code so that it will provide full or partial fair market value to computer donations from businesses.** Currently, there is virtually no uniform tax deduction benefit for US businesses to donate fully depreciated computers to charities and schools.

Tremendous growth potential for noncommercial computer reuse and refurbishing exists in the San Francisco Bay Area and the US. The field could divert much material from landfills and also help remedy the digital divide both in the US and in other parts of the world, including developing countries.

ABOUT COMPUMENTOR

Based in San Francisco, California, CompuMentor (www.compumentor.org) is one of the oldest and most comprehensive nonprofit technology assistance providers in the United States. Since 1987, CompuMentor has served over 140,000 nonprofits and schools nationwide with a unique combination of hands-on and Internet-based programs that help nonprofits at any stage of technology evolution solve immediate problems, enhance near-term productivity, and develop technological confidence. CompuMentor's hands-on services include matching technical volunteers with schools and nonprofits and providing technology consulting for nonprofits of diverse sizes and goals, from community technology centers to arts organizations and domestic violence shelters.

CompuMentor is also home of the nonprofit technology portal TechSoup (www.techsoup.org). This renowned Web site aggregates technology resources and information for the national nonprofit community and channels technology product philanthropy at a retail value of over \$150 million (in the current year) into the nonprofit sector.

ABOUT THE AUTHOR

Jim Lynch is CompuMentor's Senior Program Manager for Computer Recycling and Reuse. During his seven years at CompuMentor, Jim has developed a deep understanding of computer recycling and reuse issues and has overseen CompuMentor's efforts in this area. His projects have included developing and maintaining CompuMentor's comprehensive and free online information and referral resource for computer donors and those seeking computers (<http://www.techsoup.org/recycle>), consulting regarding the creation of the computer recycling center for the San Francisco Unified School District, designing the Recycled Computers in Schools demonstration project with Resource Area for Teachers (RAFT) in San Jose, California, and co-designing and managing CompuMentor's MAR program (which distributes Windows operating systems to recyclers/refurbishers across the country).

Jim is a member of the National Recycling Coalition and other recycling organizations and has been interviewed extensively over the years on computer recycling and related issues by National Public Radio, CNET radio, Fox TV, NBC TV, New York Daily News, The San Francisco Chronicle, San Jose Mercury News, Salon.com, Wired News, Philanthropy News Network, Chronicle of Philanthropy, and Nonprofit World Magazine.

A Unique Opportunity

The United States faces a unique challenge and opportunity regarding the disposal of obsolete computer equipment. On the one hand, three-quarters of all computers sold in the United States remain stockpiled in businesses and homes.⁵ On the other, thousands of schools, non-profits, and low-income families could greatly benefit from access to this resource. Unfortunately, no direct nationally based distribution system links this supply with this demand.

NARROWING THE DIGITAL DIVIDE

Computers are mission-critical infrastructure in schools, work, and daily life; however, it is still difficult for many nonprofits, schools, and families to acquire low- or no-cost discarded—but still useful—computers. CompuMentor research indicates demand for approximately 500,000 computers in nonprofits, schools, microenterprises,⁶ and low-income families in the Bay Area. Nationally, this demand is estimated at 28 million computers. Low-cost, refurbished computers could provide a highly viable opportunity to narrow this digital divide.

MITIGATING ENVIRONMENTAL IMPACTS

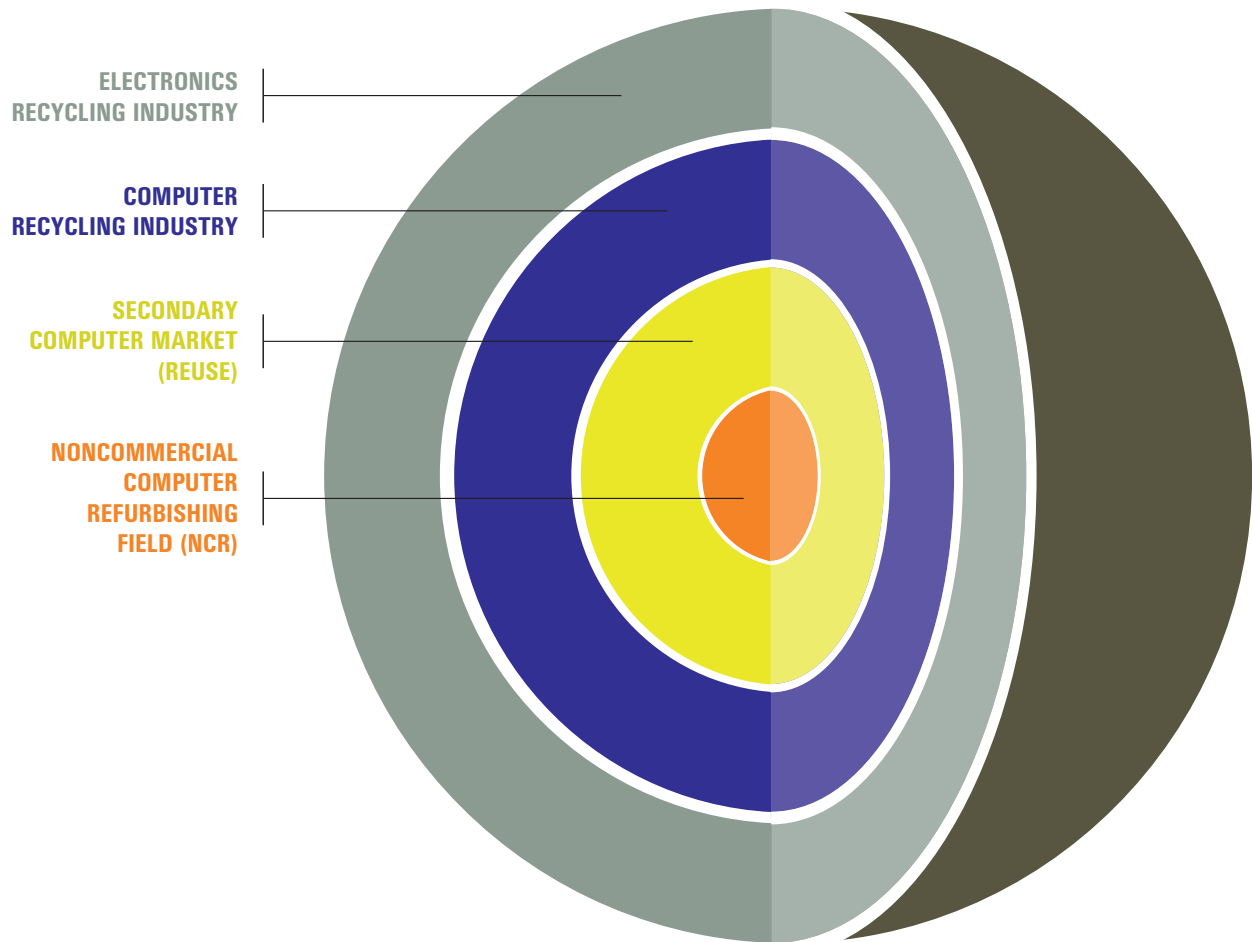
Since 1981, over a billion personal computers have been produced and sold worldwide (more than 400 million in the United States). In 2003, 57.7 million computers were sold in the US.⁷ The US Environmental Protection Agency (EPA) estimates that nearly 250 million computers will become obsolete in the next 5 years—an average of 50 million computers per year.⁸ Scott Matthews at Carnegie Mellon University finds that about 13% of US computers are being recycled and that at least 150 million PCs will be buried in US landfills by 2005.⁹ There are still no federal or state laws forbidding this practice in most of the United States. The exceptions are California and Massachusetts who have banned CRTs going to landfills. E-waste is the fastest growing portion of the entire waste stream, growing two to three times faster than any other waste stream.¹⁰ It is the largest single source of lead in municipal solid waste (about 30%).¹¹

The cost to produce a computer and monitor is immense, especially for microprocessors. Producing the average 53-pound desktop computer and monitor requires 530 pounds of fossil fuels, 50 pounds of chemicals, and 3,330 pounds of water (due to the repeated rinsing necessary). These amounts are roughly the weight of a sport utility vehicle or 1.8 metric tons. In contrast, the ongoing energy costs associated with owning a computer are relatively low—roughly the same as a refrigerator. Reselling or upgrading computers saves 5 to 20 times more energy than recycling over the computer's life cycle. It's much better for the environment to use a computer for an extra two or three years than to buy a new one every three to four years.¹²

BROAD PERSPECTIVE:

The Electronics Recycling Industry

The electronics recycling market is comprised of many different layers. For example, the noncommercial computer refurbisher (NCR) field is a specialized niche within the secondary computer market (reuse). The secondary computer market is in turn a niche within the larger overall computer recycling industry, which is a subset of the highly diverse electronics recycling industry.



The NCR field is comprised of noncommercial organizations¹³ that refurbish discarded computer equipment to help achieve a broader social mission, such as reducing the environmental impact of e-waste or helping individuals and organizations cross the digital divide. The secondary computer market may include some noncommercial refurbishers, but it is primarily comprised of commercial sellers of used computers, such as those selling on eBay.¹⁴ The computer recycling industry encompasses the NCR field and the secondary computer market, as well as the recycling of computer parts. The overarching electronics recycling industry includes all these organizations as well as those that recycle or reuse any electronic product or device such as televisions or radios.

IAER INDUSTRY ASSESSMENT

A 2003 International Association of Electronics Recyclers (IAER) report discussed the basic elements of the US electronics recycling industry. Highlights from this study are included below.

SIZE AND LOCATION

- Annual revenues are approximately \$700 million.
- The industry is comprised of 400 companies employing 7,000 employees.
- Most companies are small and new; nearly half employ fewer than 10 people.
- Approximately 100 original equipment manufacturers (OEMs) and nonprofits are involved in the industry.
- The industry is concentrated in the Eastern US.

CAPACITY AND MATERIALS PROCESSING

- The industry processes 750,000 tons of material annually.
- Over half of the materials reclaimed are metals: mostly steel, aluminum, and copper; plastics are the next most prevalent material.
- The industry is running at 50% to 75% of capacity.

COMPUTER RECYCLING

- OEMs and large companies with over 1,000 employees are the largest source of computer equipment for recycling.
- In 2001, only 11% of personal computers retired in the US were recycled.¹⁵

COSTS AND REVENUES

- The cost and revenues from electronics recycling are about equal, requiring that recycling companies charge for collection, data security, and disposal.
- Collection and transportation account for 80% of costs of electronics recycling.
- Materials recovery yields \$1.50 to \$2.00 per computer.
- Precious metals use has decreased in the manufacture of electronics over the years, which has dramatically reduced the reclamation value of computers.
- The resale of whole computers or computer parts is a significant revenue source for the recycling industry.

PROJECTIONS

- Approximately 140 million computers will enter US landfills by 2005.¹⁶
- The industry now processes 40 million units (e.g., TVs, monitors, CPUs, and printers) per year.
- The industry is expected to experience growth of 400% to 500% in the next few years due to the steady flow of electronic equipment becoming obsolete, and to the large volume of obsolete computers estimated to remain in storage in homes, companies, and schools.
- The estimated volume is expected to reach 400 million units per year by 2010.

INDUSTRY SEGMENTS

- Asset management (inventory, planning, resale).
- Brokering (auction, resale, export).
- Reuse (refurbishing, remanufacturing, resale at the product level).
- De-manufacturing (disassembly and separation of reusable or saleable parts).
- Recovery of parts and subassemblies (testing, classifying, reuse, sales).
- Materials recovery and recycling (separating materials, such as plastics, metal, and glass).
- Materials processing and refining (shred, grind, pelletize materials).

THE THREE R'S OF THE COMPUTER RECYCLING INDUSTRY

Recycling refers to sorting, processing, and converting computer equipment into raw materials that can be used for new products, which may or may not be computers.

Reuse, as the name implies, refers to reusing discarded computers. These reused computers may or may not require upgrading or “fixing” before they are reused. They may be purchased commercially, as on eBay, or obtained through a noncommercial computer refurbisher.

Refurbishing refers to the practice of upgrading or making discarded computers functional, which often entails wiping data from hard drives and installing operating systems. Refurbishing is a type of computer reuse. Some computer refurbishers supply the commercial market, but most support the noncommercial—or nonprofit—sector.

THE SECONDARY COMPUTER MARKET

The overall personal computer industry is now relatively mature with just a few major original equipment manufacturers (OEMs) like Dell and HP dominating the US and world markets. Dell and HP now account for nearly half the computers sold in the US and 30% of the computers sold worldwide.¹⁷ The market is also sizeable. In 2003, approximately 169 million computers were sold worldwide and 58 million computers were sold in the US. In 2004, Gartner estimates that sales will increase 14% in the US to approximately 66 million computers.¹⁸ Since 1981, over a billion personal computers have been produced and sold worldwide, with over 400 million produced and sold in the US alone.¹⁹

A significant number of these computers have found their way into the secondary market, which includes both commercial and noncommercial computer resellers. By 1998, the secondary market in the US was estimated at \$6 billion in sales with an annual growth rate of 17%.²⁰ The dot com bust in 2001 put additional serviceable computer equipment on the secondary market.

Online auctions like eBay are a major factor in the growth of the secondary computer market. In 2001, eBay sales of computer equipment reached approximately \$2 billion, of which 60% was for used or refurbished computer equipment. Even US business computer users are starting to find reused computer equipment useful and cost-effective. According to a 2002 *CIO Magazine* survey of 187 information executives, 77% surveyed have purchased secondary computer equipment and 46% surveyed expected to increase their spending on secondary computer equipment in 2003 by an average of 15%.²¹

At the Stanford University Recycling Conference held on October 10, 2003, Robin Ingenthron of American Retroworks suggested that the secondary computer market's relation to the new computer market increasingly resembles that of the US used car market's relation to the new car market; the used car market is approximately seven times larger than the new car market.

AMERICAN RETROWORKS INC. is a recycling management company specializing in markets and logistics with facilities and services offered in the Northeast and New England.

Noncommercial Computer Refurbishing

Although commercial reuse, such as that facilitated by online auctions, is the dominant component within the secondary computer market, noncommercial refurbishing also plays an important role. Noncommercial computer refurbishers tend to target their services to support individuals and communities in need rather than selling to anyone able to meet their price.

HIGH DEMAND FOR REFURBISHED COMPUTERS

A significant digital divide still exists in the United States, despite the universal adoption of computers as mission-critical infrastructure in public schools, work, and daily life. Over the last year, CompuMentor has measured critical areas of the digital divide in which an unmet demand for computers still exists. We found that several distinct groups within the US economy could readily benefit from access to refurbished computer equipment, including nonprofits, schools, microenterprises, and low-income families.

NONPROFIT SECTOR

The nonprofit sector is one of the largest underserved business markets in the US.²² Over 1.6 million nonprofit organizations employ more than 10.6 million people, which roughly equates to one in fifteen Americans.²³ The nonprofit sector also contributes a surprisingly large amount to the US gross domestic product. The sector's annual revenues of \$700 billion and assets of \$2 trillion reflect about 6.7% of the US GDP — more than banking, technology, or the federal government.²⁴

And the sector is growing. In recent years, the nonprofit sector grew faster than the rest of the US economy. Its annual growth rate of 5.1% is greater than that of the national gross domestic product (3.1%) and, over the last few years, the sector added over 80,000 organizations per year.²⁵

However, despite their significant, cumulative contributions to the US economy, most nonprofits are small. Only 18% have operating budgets of \$1 million or more and, of those with forecasted revenues, only 40% have annual operating budgets over \$100,000.²⁶ In fact, a large number of nonprofits have no operating budget at all. Over half the nonprofit organizations in the Bay Area, for instance, function as all-volunteer programs.²⁷

Given these budget statistics, it is not surprising that only 39% of nonprofits have line item technology budgets and approximately 40% of nonprofit workers do not have access to Internet-capable computers.²⁸ This large unmet need among nonprofits for low- or no-cost computer equipment is further exacerbated by grantmaking and donor funding mechanisms which generally do not invest in organizational infrastructure, such as IT systems, staff development processes, and adequate management capacity.²⁹

CompuMentor's experience suggests a brisk demand for low-cost computer hardware among nonprofits. In 2002, CompuMentor surveyed TechSoup.org and TechSoup Stock³⁰ users regarding their technology needs. Of the 553 respondents, 85% stated a need for low- or no-cost desktop computers, 78% for monitors, 73% for laptops, and 54% for printers.³¹

MicroMentor supports the availability of low-cost recycled computers, software, and computer skills training as crucial to the viability of the 20 million small micro-businesses in the nation's low-income urban neighborhoods and rural areas. Nearly all of these small enterprises—and microenterprise programs—need this resource.

DAVID RAND, DIRECTOR,
MICROMENTOR, THE ASPEN INSTITUTE

This demand for computer equipment reflects a real operational need among nonprofits. According to a 2002 CompassPoint survey of Silicon Valley nonprofits,³² the great majority of nonprofits surveyed (85%) rely on some form of information technology. Like most organizations, nonprofits use computers to support critical services and administration needs. The majority of usage patterns are for five basic applications:

- **Word Processing:** 96.5% of survey respondents
- **Accounting/Financial Management:** 90.8% of survey respondents
- **Internet/Web Access:** 88.0% of survey respondents
- **E-mail:** 83.8% of survey respondents
- **Databases:** 83.1% of survey respondents

The 2001 Gifts In Kind Technology Tracking Study of the Nonprofit Sector corroborates these findings. It finds that word processing, virus protection, spreadsheets, accounting, and email are universally used applications in the nonprofit sector.³³

In a 2003 recycled computer installation project sponsored by the Richard and Rhoda Goldman Fund, CompuMentor found that the four-year-old working computers now in the discard stream in large numbers (Pentium II 350 to 500 MHz) can perform all of these functions quite adequately.³⁴

In the San Francisco Bay Area, we estimate the current nonprofit sector demand for computers to be 96,000 units,³⁵ which far exceeds capacity in the area. We estimate the number of computers needed by nonprofits throughout the US to be 4.24 million, which again exceeds current capacity.³⁶

LOW-INCOME FAMILIES

The digital divide for low-income families in the United States is still significant. According to the latest digital divide statistics from the US Department of Commerce National Telecommunications and Information Administration, 40% of US families do not have Internet-capable computers. These figures also indicate that only 61% of Californians have computers and that the national average is just under 57%.³⁷ In the San Francisco Bay Area, a poll completed by the Bay Area Council in December 2002 found that about 25% of Bay Area residents do not use Internet-capable computers.³⁸

According to the 2000 US Census, the San Francisco Bay Area population was 6.8 million, which included 1.6 million families. Based on the 25% at-home Internet access levels determined by the Bay Area Council, these figures translate into approximately 640,000 families on the wrong side of the digital divide.

We estimate the demand from low-income families in the San Francisco Bay Area to be about 160,000 computers.³⁹ A national estimate for the shortfall of computers in homes is approximately 10.5 million, according to Computers for Schools Chicago.⁴⁰

THE MICROENTERPRISE SECTOR

Another important area of demand for low- or no-cost recycled computers is in the “microenterprise” sector. A microenterprise is a commercial enterprise that has five or fewer employ-

Steve Hargadon of Hargadon Computer, a California-based commercial supplier of recycled computers, reports that state budgetary shortfalls have had a dramatic impact on their school sales:

Because of the current economy, and specifically the impact that it has had on school budgets, our sales this year are down about 30% from last year. Compound that with a lower sale point—meaning that the average sale price per computer has also dropped (and so has its corresponding profit)—and you can see why many computer dealers are struggling.

STEVE HARGADON, FOUNDER,
HARGADON COMPUTER

ees, one or more of whom owns the enterprises.⁴¹ Often family-owned businesses, microenterprises are generally small enough to benefit from loans of under \$25,000 but are often too small to access commercial banking services. The microenterprise movement in the US involves all the tiny businesses that open up in the country's poorest neighborhoods to provide goods and services like beauty and nail shops, yard maintenance, small bakeries or delis, lunch wagons, etc. This sector accounts for 16.4% of US employment and 16% of employment in the Bay Area. These percentages translate to 553,000 businesses in the Bay Area, 2.5 million in California, and 20.2 million microenterprises in the US.⁴²

Microenterprises have technology needs that are little different from those of other small businesses. All businesses need some type of system that facilitates the flow and documentation of business transactions. While a manual bookkeeping log may suffice for a start-up business, a growth-oriented entrepreneur may find it easier to stay disciplined and on track by using bookkeeping software.⁴³ A small rural handicraft business seeking markets, for instance, may find it useful to post a simple Web site, develop email marketing, and online marketing and search engine placement capability.

Nobody seems to have estimated the exact need for computers in this sector of the economy, but if a quarter of all microenterprises need low- or no-cost computers, it amounts to approximately 135,000 computers in the Bay Area and 5 million nationally.

PUBLIC SCHOOLS

Public schools have made great strides towards integrating computers into their curricula. Four out of five children ages 6-17 use computers at school and, in 83% of schools, at least half the teachers use computers daily for planning, teaching, or both.⁴⁴

However, these access and use levels are still below estimated need. Nationally, there are 5.6 students per Internet-capable instructional computer (or about 9 million PCs in classrooms today).⁴⁵ The US Department of Education target for computers in schools is a 4:1 student:instructional computer ratio.⁴⁶ Based on these statistics, we estimate a shortage of roughly 2.7 million computers nationally.

This estimated need increases when the functionality and age of these computers is factored into the equations. The most frequently used operating system on instructional computers is Windows 98 (40%). Microsoft is currently scheduled to end its paid incident support for Windows 98 on June 30, 2006, which is extended from an earlier support end date of January 16, 2004.⁴⁷ No-charge incident support and extended hotfix support for Windows 98 and Windows 98 Second Edition ended on June 30, 2003.⁴⁸ In addition, according to Computers for Schools Chicago, the average age of computers in public schools is seven years and roughly 6.5 million need to be replaced.⁴⁹ This figure combined with the previously mentioned 2.7 million shortfall suggests that current demand for functional instructional computers exceeds 9 million computers nationwide.

Our assessments for the San Francisco Bay Area suggest that approximately 175,000 computers are in the schools now and that 70,000 additional computers are needed to reach a 4:1 student:instructional computer ratio. We estimate that another 70,000 computers need to be upgraded or replaced due to age (over five years old). Therefore, we estimate the current total local need is approximately 140,000 computers.⁵⁰

For the next few years, state budget cuts throughout much of the US will dramatically slow the growth of computer infrastructure in schools. For example, in August 2003, one of the largest and most successful noncommercial computer refurbishing projects in the country, the Students Recycling Used Technology (StRUT) program in Oregon had to shut down its operations due to Oregon Department of Education budget cuts. StRUT pioneered a way to use computer refurbishing in high school vocational education. Just before the program closed, it had computer refurbishment training programs in over 130 schools in Oregon, supplying 35,000 computers to the Oregon Schools. The program diverted 6 million pounds of e-waste from landfills and provided hands-on training to over 20,000 students over the course of eight years.⁵¹

SUMMARY OF ESTIMATED DEMAND

The table below lists estimated demand levels for refurbished computers on both a local and national level.

TABLE 1
ESTIMATED DEMAND FOR
REFURBISHED COMPUTERS

	SAN FRANCISCO BAY AREA	UNITED STATES
Nonprofits	96,000	4.2 million
Low-income families	160,000	10.5 million
Microenterprises	135,000	5 million
Schools	140,000	9 million
TOTAL NEED	531,000	28.7 MILLION

LOW SUPPLY OF REFURBISHED COMPUTERS

In initial surveys of noncommercial computer refurbishers, CompuMentor found that corporate and government donations comprise the bulk of computer donations and that noncommercial refurbishers favor these donation sources because they often provide newer, more robust, and more consistent equipment. Based on these findings, CompuMentor sought more specific data on corporate computer disposal practices to gain a better understanding of motivations and concerns affecting behavior in this area.

The overall finding was that San Francisco Bay Area businesses are very interested in donating computers, but they have concerns regarding whether charity computer refurbishing is a viable option given their need to ensure data security, understand where donations have gone, and avoid costs and liabilities associated with computer disposal.

SURVEY OF SAN FRANCISCO BAY AREA BUSINESSES

In March and April of 2003, a research team comprised of representatives from CompuMentor, New Sector Alliance, Accenture, and UC Berkeley’s Haas School of Business, surveyed San Francisco Bay Area corporations and institutions regarding their practices and attitudes towards computer disposal and recycling. Funded by the Richard and Rhoda Goldman Fund, this project’s main objective was to gauge the potential supply of computers for the noncommercial computer reuse field.⁵²

The 15-question online survey posted on Survey Monkey targeted corporations in the San Francisco Bay Area. The 67 respondents reflected a wide range of company and institution sizes.

TABLE 2
SURVEY PARTICIPANT SIZE

ORGANIZATION SIZE <i>in number of employees</i>	PERCENT OF SURVEY RESPONDENTS
1–100	29.7%
100–1,000	23.4%
1,000–10,000	31.2%
10,000–50,000	10.9%
50,000 or more	4.7%
NUMBER OF RESPONDENTS: 60	

Numerous large organizations—those with at least 1,000 employees—participated in this survey, including the following:⁵³

- **Applied Materials**
- **Bank of the West**
- **BEA Systems**
- **City of Livermore**
- **Clorox**
- **Gallo**
- **The Gap**
- **Genentech**
- **Intel**
- **Intuit**
- **Kenneth Cole Productions**
- **McKesson**
- **McKinsey & Co**
- **Nordstrom**
- **Oracle**
- **Peet’s Coffee and Tea**
- **Pixar**
- **Purdue University**
- **Sun Microsystems**
- **Siebel**
- **Solelectron**
- **Symantec**

The survey also included 19 small companies with 100 or fewer employees, and 15 companies with between 100 and 1,000 employees.

As summarized below, survey participants were asked a range of questions regarding their computer recycling practices, including how frequently they replace existing equipment with new equipment (“refresh rates”) and what factors influence their decisions to donate or discard their computer equipment.

Refresh Rates

Participants were asked how often their company swapped out or “refreshed” computers. The most frequently selected refresh rate was “Every Three Years.”

TABLE 3
REFRESH RATES

FREQUENCY OF REPLACEMENT	% OF RESPONDENTS
Every year	3.3%
Every 2 years	10.0%
Every 3 years	30.0%
Every 4 years	13.3%
More than 4 years	8.3%
No refresh rate policy	35.0%
NUMBER OF RESPONDENTS: 60	

Disposal Costs

Participants were asked both how many computers they dispose of each year and what they estimate their current per computer disposal costs to be. The majority dispose of 100 or fewer computers each year and pay disposal rates ranging from \$0 to \$25.

TABLE 4
NUMBER OF COMPUTERS
DISPOSED OF PER YEAR

# OF COMPUTERS DISPOSED PER YEAR	% OF RESPONDENTS
0 – 50	50.0%
50 – 100	11.0%
100 – 500	21.0%
500 – 1,000	6.5%
1,000 – 3,000	6.5%
Above 3,000	35.0%
NUMBER OF RESPONDENTS: 62	

TABLE 5
DISPOSAL COST PER COMPUTER

CURRENT COST OF DISPOSAL PER COMPUTER	% OF RESPONDENTS
\$0 - \$25	74%
\$25 - \$40	22%
\$40 - \$75	0%
More than \$75	4%
NUMBER OF RESPONDENTS: 54	

Factors Influencing Computer Disposal

Participants ranked different factors that could affect their computer disposal decisions. Destroying data and diverting computers from landfills were the top-ranked factors. This question was designed to help assess how philanthropic and environmental concerns compare with more pragmatic needs like data security and cost recovery.

TABLE 6
FACTORS AFFECTING COMPUTER DONATIONS

INFLUENCING FACTOR	VERY IMPORTANT	IMPORTANT	SOMEWHAT IMPORTANT	NOT IMPORTANT
Destroying data	84%	10%	5%	2%
Keeping computers out of landfills	62%	23%	8%	7%
Keeping disposal costs down	52%	37%	12%	0%
Donating to schools and nonprofits	33%	40%	20%	7%
NUMBER OF RESPONDENTS: 62				

Computer Disposal Patterns

When asked about current computer disposal practices, more than half of the respondents indicated that they currently donate some equipment to schools or nonprofits. Individual comments revealed some challenges in this area, however. Several respondents commented that they have tried different ways of donating—such as directly to schools or nonprofits or starting nonprofit refurbishing programs—but that the process remained problematic. Furthermore, a significant percentage did not answer the question (40%).

TABLE 7
COMPUTER DISPOSAL PRACTICES

COMPUTER DISPOSAL PRACTICE	% OF RESPONDENTS
Donate at least some equipment to schools or nonprofits	54.0%
Use commercial recyclers	46.0%
Store equipment for use as parts	41.0%
Sell or donate equipment to employees	37.0%
Throw out the equipment	16.0%
Have a lease or manufacturer take-back arrangement	14.0%
Sell the equipment on the secondary market	11.0%
Unclear on disposal practices for computers	5.0%
Other ⁵⁴	17.5%
NUMBER OF RESPONDENTS: 57	

Disposal Patterns and Organization Size

Survey results suggest that small, medium, and large organizations donate at different levels. Large organizations were the most the likely to donate equipment (either directly to schools or to a recycler).

TABLE 8
COMPUTER DISPOSAL PATTERNS

ORGANIZATION SIZE	% DONATING COMPUTERS TO SCHOOLS & NONPROFITS	% SENDING COMPUTERS TO EQUIPMENT RECYCLERS
Small	28%	21%
Medium	61%	50%
Large	70%	72%
NUMBER OF RESPONDENTS: 54		

Choosing Refurbishers

When asked what attribute is most important in choosing a refurbisher for charity computer donations, the majority of respondents said that they need a high degree of assurance that their data is erased. The next largest concern is that donations go to deserving charities and schools and not to public resale. Finally, a number of respondents stated that they wanted donating to be much easier than it currently is in terms of arranging equipment pickup and getting trustworthy reporting on disposition.

Donation Incentives

When asked to rank factors that might provide added incentive to donate computers to nonprofits and schools, respondents ranked diverting computers from landfills first (54%) and making the donation process more convenient second (31%).

TABLE 9
INCENTIVES TO DONATE USED COMPUTER EQUIPMENT

INFLUENCING FACTOR	VERY IMPORTANT	IMPORTANT	SOMEWHAT IMPORTANT	NOT IMPORTANT
Diverting computers from landfills	54%	23%	16%	7%
More convenient donation options	31%	51%	7%	11%
Increased profile as a corporate citizen	14%	50%	21%	14%
Selling computers to recover costs	9%	21%	21%	49%
Monetary gains (i.e., tax incentives)	5%	30%	25%	40%
NUMBER OF RESPONDENTS: 62				

Donations to Nonprofits and Schools

Only 15 respondents answered this question, suggesting uncertainty on this particular issue among survey participants. Responses ranged from donation levels of 0% to 100% with the average nonprofit/school donation rate at 29%.

Of the respondents, 17% donated at a rate higher than 75%. These respondents included one city, one high tech company, a large utility, two retail clothing companies, a law firm, and a foundation.⁵⁵ All but two of these respondents had over 1,000 employees.

Conclusions on the Supply Survey of Bay Area Businesses

Survey results suggest that the key drivers for reuse and recycling of used computers in San Francisco Bay Area companies are data security, costs of disposal, convenience, and corporate citizenship.

Reasons hampering donation to refurbishers:

- **Lack of awareness of where to donate**
- **Small disposal schemes have large costs, and are not cost effective**
- **Lack of trusted service providers for data security and proper disposal**

The supply of computers from businesses to noncommercial refurbishers is not high, largely due to lack of visibility of the field and the lack of a large-scale donation mechanism. The majority of reusable computers donated to schools and nonprofits by survey participants were directly donated, as opposed to being channeled through refurbishers.

TAX INCENTIVES

One of the important findings of this study is that IRS donation laws combined with asset management procedures and generally accepted accounting practices create little or no incentive for businesses to donate computers to charities and schools. No uniform or substantial tax benefit currently exists for these business computer donations.

Over the past year, CompuMentor asked many companies interested in donating computers if they were aware of the tax laws and legal incentives for in-kind charitable donations. Most were not, which is not surprising given the complexity of tax deduction options for businesses. According to CompuMentor's follow-up with legal counsel regarding this issue, there is generally no tax deduction value for computers that are fully depreciated. However, if businesses donate partially depreciated computers, they may receive a deduction for part of the computer's fair market value.

In continued conversations with business donors, CompuMentor found that many companies follow the accepted accounting practice of depreciating computers over three years and that some companies fully expense the computers at time of purchase. In either case, there is lit-

the tax benefit for US businesses to donate computers to schools or charities because most computer donations involve at least three-year-old equipment (which has been either fully depreciated or fully expensed). These policies likely discourage charitable business computer donations and, in fact, may encourage lower cost disposal options including domestic landfills and secondary markets that tend to flow overseas—sometimes referred to as foreign dumping.

Federal Legislation

Two Federal laws, which have now expired, encouraged the donation of computers to schools and charities: the 21st Century Classrooms Act and The New Millennium Classrooms Act.

- **THE 21ST CENTURY CLASSROOMS ACT** was signed into law as part of the Taxpayer Relief Act of 1997 and had a five-year life. It provided expanded tax incentives to corporations that donate two-year-old or newer computer equipment and software to schools and nonprofits involved in primary and secondary education. The law also facilitated the donation of surplus equipment and technology to schools and libraries from federal or state governmental agencies, businesses, and other private entities.
- **THE NEW MILLENNIUM CLASSROOMS ACT** built on the tax credits included in the 21st Century Classrooms Act, and related to donations that went to nonprofit refurbishers who supplied computers to schools. This law pertained to section 170E6 of the Federal Income Tax Code. It offered an increased deduction above the undepreciated value for donated computers to schools or public libraries, extended the age of the eligible computer equipment from two to three years, and expanded the definition of “allowable donors” to include original equipment manufacturers or re-acquirers, like asset recovery or equipment leasing businesses. The New Millennium Classrooms Act provided a tax credit equal to 30% of current fair market value of the donated computer equipment, and increased it to 50% if recipients were located in a specially qualified area (enterprise community, empowerment zone, or Indian reservation). This bill was in effect from 2000 to 2003.

Two new US federal bills are now under consideration. One is the Child Pact Act (HR 2694), which facilitates the transfer of surplus computers from US Federal agencies to schools and nonprofit refurbishers. It strengthens an Executive Order (12999) from 1994. The other is the Jumpstart Our Business Strength Act (S. 1637), which decreases the ease and value of in-kind donations by limiting the tax deductions individuals and corporations can take on non-cash contributions. If signed into law, the legislation will no longer permit individual donors to take a fair market value tax deduction, but will require charities to supply receipts to donors showing how much a donated item sells for and will limit the donor’s deduction to that amount.

This study strongly advocates additional federal legislation to amend Section 170 of the US Federal Income Tax Code to provide full or partial fair market value to computer donations from businesses.

2003 COMPUMENTOR SURVEY OF NONPROFIT REFURBISHERS

In 2003, CompuMentor conducted a 30-question survey of nonprofit computer refurbishers. This survey was conducted with the assistance of Catalyst Alliance, Haas School of Business Center for Responsible Business, and a team of Accenture volunteers.

Interviewees included a cross-section of 10 nonprofit computer refurbishers in the San Francisco Bay Area and nine nonprofit computer refurbishers in other parts of the country. The interviews were conducted by phone or in person and focused on the current capacity of refurbishers and the factors that would affect capacity going forward. Results were combined with the survey data captured from the Microsoft Authorized Refurbisher (MAR) Program in September 2003.

Survey results relating to market components, operations, and services are summarized below.

Launched in December 2002, the Microsoft Authorized Refurbisher (MAR) Program provides Windows 98 and Windows 2000 operating systems to noncommercial PC refurbishers at a handling fee of \$5 per license. MAR has quickly become integral to the noncommercial refurbishing movement. The program is discussed in greater detail in the *Industry Developments* section of this study.

OVERALL MARKET

- Businesses supply the majority of computer hardware donations in the San Francisco Bay Area. Government is another major source of donations, especially in the Midwestern and Eastern parts of the country. Donations from individuals account for a smaller portion of the donation stream.
- Schools were the end users for the majority of computers supplied by refurbishers in all parts of the country (50%). Low-income families are the end-recipients of 23% of donated computers, and nonprofits receive 27%.
- In the San Francisco Bay Area, 75% of refurbishers only accept computers at a Pentium II level or above. In other parts of the country, 80% of refurbishers accept Pentium I computers and 20% accept all computer donations.
- Refurbisher responses were mixed on whether computer supply or demand is greater. As one respondent reported, "Supply of computers isn't a problem; supply of good computers is the problem."
- Two variables seemed to have the most impact on supply and demand: how entrepreneurial the refurbishers were in soliciting computer donations, and the cost, if any, to recipients. Not surprisingly, free computers resulted in higher demand estimates.

A significant portion of hardware donations to refurbishers is nonworking... This high level of nonworking equipment is a primary reason why it is more effective and less wasteful to donate computers to refurbishers rather than directly to schools and nonprofits. Refurbishers are much better equipped to test the computers, refurbish them if possible, and responsibly dispose of e-waste if appropriate.

OPERATIONS

- Nonprofit computer refurbishers typically employ two or three paid staff and 30 or 40 volunteers or students.
- Nonprofit refurbishers operate on very small budgets, which primarily cover salaries and warehousing costs. They typically devote their energies to seeking useful computer donations, sorting equipment, refurbishing it, distributing it, and disposing of e-waste. They often have little time or resources for administration or record keeping.
- Most refurbishers surveyed report that they expect their capacity to double in the next three years, or grow at 20% to 30% per year.
- Over half of the refurbishers surveyed reported that they have a two-week or less waiting period to supply computers to schools, nonprofits, or individuals who apply for them. Refurbishers that do not charge equipment fees typically have much longer waiting periods.

COSTS AND FEES

- Nearly half of the refurbishers surveyed could not quantify their cost per unit for refurbishing computers. Those that did estimate their cost per unit reported a range from \$25 to \$200 per computer.
- The study found no standard price for computers in the noncommercial computer refurbishing field.
- 60% of refurbishers surveyed did not charge fees of their computer recipients.
- Larger refurbishers tended to charge between \$0 and \$30 for computers over three years old, and \$100 to \$150 or more for newer computers.

DATA SECURITY

- 66% of refurbishers reported that they are able to clean data properly from donated computers as part of their process, but only the larger refurbishers report doing so routinely.
- Refurbishers reported that 75% of donating companies clean their computers of data before donating them and that 60% to 70% of individual donors leave data on the computer. Individual donors do not often express concern to the refurbishers about data security.
- 75% of respondents reported that they supply some sort of warranty, most often a swap arrangement in which computer recipients trade broken equipment for working equipment.

ADDITIONAL STUDIES

Two recent studies corroborate and augment CompuMentor's 2003 Survey of Nonprofit Refurbishers. One study, by the Northeast Recycling Council, focuses on the differences between nonprofit and for-profit computer refurbishing entities. The other, by independent researcher Elliot Harkavy, surveyed five nonprofit computer refurbishers in the Northeastern US.

NORTHEAST RECYCLING COUNCIL

In August 2003, the Northeast Recycling Council (NERC) published a Used Electronics Market Study⁵⁶ that surveyed 23 commercial and 11 nonprofit refurbishers in seven Northeast US states.⁵⁷

This study largely compares and contrasts nonprofit and for-profit computer refurbishing programs in the Northeastern US whose services are targeted at nonprofits and schools. The main findings of this baseline study are summarized below.

Organizational Statistics

- **Commercial and noncommercial computer refurbishers account for 2% of the overall computer recycling industry.**
- **For-profit electronics refurbishing companies employ twice as many paid employees as nonprofit refurbishers.**
- **The field is volatile, so a majority of respondents—54% of for-profits and 77% of nonprofits—could not give an opinion on projected employment growth.**
- **Brokering, the practice of reselling reusable parts or whole computers, is significantly more common among nonprofit refurbishers than commercial refurbishers.**

Materials Processing

Resale charges and the types of preferred equipment are similar between nonprofit and for-profit refurbishers. However, while for-profit organizations accept a wider range of donated equipment, they also tend to charge more acceptance fees. Nonprofit refurbishers appear to be able to offset the need for acceptance fees through grant revenue. Responses related to materials processing are summarized in the table below.

TABLE 10

**MATERIALS PROCESSED BY
NONPROFIT AND FOR-PROFIT
REFURBISHERS**

	NONPROFIT	FOR-PROFIT
Materials accepted	Restricted	Broad
Acceptance fees	Low or no fees for accepted donations	Fees for most donations
Primary donors	Business	Business
Negligible donors	Individuals	Individuals
Preferred donations	Whole computer components e.g., CPUs, CRTs, laptops, keyboards	Whole computer components e.g., CPUs, CRTs, laptops, keyboards
▪ Laptops	For-profits process twice the number of laptops than nonprofits	
▪ CPUs	For-profits process twice the number of CPUs than nonprofits	
▪ CRTs	For-profits & nonprofits refurbish a comparable number of CRTs	
▪ Keyboards	For-profits & nonprofits refurbish a comparable number of keyboards	
Televisions	Not a preferred donation; only 50% of respondents accept	Not a preferred donation; only 50% of respondents accept
Resale fees	50% charge	50% charge
Primary revenue	Grants and acceptance fees	Acceptance fees

Customer Services

As illustrated in the table below, nonprofit refurbishers allocate relatively more of their operating budgets into supporting their customers through technical support and warranties than do for-profit programs.

TABLE 11

**OPERATING EXPENSE ALLOCATIONS
BY NONPROFIT AND FOR-PROFIT
REFURBISHERS**

	NONPROFIT	FOR-PROFIT
Technical support	64%	23%
Warranties	55%	36%

In addition, almost two-thirds of the nonprofit refurbishers erase the hard drive and provide new operating system software as a standard business practice. Of the remaining one-third, half charge for data removal upon request of the computer donor.

International Distribution

Both nonprofit and for-profit organizations distribute refurbished computers to destinations outside the US.

- **45% of all survey respondents engage in some degree of international export.**
- **Only two of the eleven nonprofit refurbishers reported international distribution programs.**
- **The three major international destinations for computers from refurbishers are Asia (38%), South America (21%), and Africa (14%). Nigeria and South Africa comprise 50% of the Africa market.**
- **In the Americas, Central America receives 26% of the used computers exported from the US, twice the number of used computers exported to Mexico (13%) or Venezuela (13%).**

Market Development

In terms of economic viability, the NERC report concludes that the computer refurbishing field is dependent on increased market development. Some of the key market development opportunities identified by the study:

- 1. Government, consumers, and industry are potential untapped sources of quality material for refurbishing.**
- 2. Businesses, institutions, and industry should be targeted for increased electronics reuse.**
- 3. Computer refurbishing will be enhanced by consumer support similar to what is provided at retail, including:**
 - **Operating software provided with the units**
 - **Technical assistance provided to consumers**
 - **Warranties on hardware**
 - **End of life take-back**
- 4. Refurbishing companies need to ensure that exported materials are dealt with in an environmentally sound manner.**
- 5. Asset recovery may present an opportunity for nonprofit organizations, if data security can be guaranteed.**

Level of Noncommercial Computer Refurbishing

We do question the NERC study finding that noncommercial computer refurbishing accounts for 2% of the overall computer recycling industry. We know that the 11 nonprofit refurbishers may be representative in the study's seven states, but they are not the entire nonprofit computer refurbishing field. Over 250 nonprofit and school-based refurbishing programs already participate in the 13-month-old Microsoft Authorized Refurbisher (MAR) program and many more are expected to join. We believe that this nonprofit part of the equation is much larger than the NERC study suggests.

ELLIOT HARKAVY

In 2003, independent researcher Elliott Harkavy surveyed four nonprofit programs: Per Scholas, Oregon StRUT, University of Pennsylvania Center for Community Partnership, and Forest Park High School.⁵⁸ Findings relevant to this study are summarized below:

- **Because they often contain significant amounts of very old and nonworking stored equipment, an organization's initial computer donation often includes large quantities of unusable equipment (upwards of 70%). Subsequent donations yield approximately 70% reusable computers.**
- **The cost to refurbish one computer is approximately \$50.**
- **The current base model in the donation stream is a Pentium II or Celeron 333 megahertz with a 4-gigabyte (or larger) hard drive.**
- **Refurbishers charge up to \$10 to accept CRTs, but charge no other intake fees.**
- **Some programs refurbish printers, reselling them for approximately \$50 or less.**
- **Monitors, keyboards scanners, and other peripherals are not usually refurbished. They are reused if they are working and scrapped if not.**

Industry Challenges

Despite indications that the secondary market is growing, a coherent, robust computer recycling system does not exist in the US. The secondary market—and noncommercial computer refurbishing in particular—is a relatively stunted portion of the larger electronics recycling industry. Three main factors seem to have made donating, refurbishing, and reusing computers difficult: a lack of industry coordination and leadership, misconceptions regarding the viability of used equipment, and the costs of processing the donated equipment.

Due at least to these factors, estimated near-term levels for computer recycling are not high. H. Scott Matthews of Carnegie Mellon University estimates that by 2005, only 12% of US computers will be recycled and 26% of discarded computers will go to landfills.

MISCONCEPTIONS REGARDING USED EQUIPMENT

Two main misconceptions regarding the usefulness of used computer equipment relate to equipment lifespan and the ongoing costs of owning used computer equipment.

EQUIPMENT LIFESPAN

According to several sources,⁵⁹ the average initial lifespan for computers in the US is three-and-a-half years. This computer obsolescence is largely driven by rapid software and hardware upgrades, rather than by hardware failure. Software companies typically upgrade their software products every couple of years as a routine business practice. These upgrades often add features that take advantage of the increasing processing power of new computer hardware. As a result, new software applications have frequently required more powerful computers.

However, computer hardware components do not wear out like other machine parts, such as automobile engines. The previously cited IAER study states that the hardware in desktop computers has an effective lifespan of at least six years.⁶⁰ H. Scott Matthews of Carnegie Mellon University estimates a lifespan of seven years⁶¹ before various components, notably hard drives, start to malfunction.

Computers are viable as long as their hardware can support needed software. Unlike the computers in the waste stream through the mid-1990s, the Pentium II and III computers now being disposed of in great quantities can very capably drive the applications that most users need: word processing, spreadsheets, desktop-scale databases, Internet browsing, and email. These computers also can comfortably run Microsoft Office XP or the latest version of Open Office.

COST OF OWNERSHIP FOR SCHOOLS AND NONPROFITS

Another issue stunting the development of the secondary computer market relates to the perceived cost of ownership. Refurbished computers are perceived to be more costly to maintain

than newly purchased equipment due to hard drive failures and the personnel cost of maintaining older equipment.

As part of its work funded by the Richard and Rhoda Goldman Foundation, CompuMentor assessed the cost of owning refurbished computers. The objective was to test, in a variety of nonprofit settings, the cost of ownership and suitability of four-year-old recycled computers, typical of those now prevalent in the donation stream.

CompuMentor supplied technology assessments, Pentium II 350 MHz recycled computers installed with Windows and MS Office software, monthly onsite scheduled support, and phone and email technical support to four diverse, local nonprofits that needed computers.

The recycled equipment was obtained from two sources: the North County Regional Occupational Program, a school-based computer refurbishing program in Sunnyvale, California; and Resource Area for Teachers (RAFT), a nonprofit refurbisher in San Jose, California. In the course of implementing this project, CompuMentor also built a mini-refurbishing operation with a server, Symantec Ghost software, and six bench stations to perform quality control.

Through this project, CompuMentor tested the suitability of recycled computers in four different nonprofit environments: an organization retiring all of its existing computers and replacing them, a community technology center (CTC) adding computers to an existing computer system, an organization adding computers to an existing administrative network, and a new community technology center (CTC) with no existing computer network at all.

Preliminary findings support the hypothesis that the four-year-old computers now prevalent in the donation stream are suitable to the work for which nonprofits need computers (office applications, accounting applications, client and donor databases, email, and Web browsing). After four to five months of operation, no significant equipment failures occurred, and scheduled support maintenance was routine (no different than the scheduled support that CompuMentor provides for new equipment). In sum, the cost of ownership for refurbished computers was identical to that of new equipment.

EQUIPMENT PROCESSING COSTS

Another significant factor limiting the development of the secondary market relates to direct processing costs for recycling and refurbishing, such as disposal costs and operating system installation.

PC DISPOSAL COSTS

According to Frances O'Brien of Gartner, Inc., there is little economic value in most machines that are more than three years old; however, there are legal and economic risks to enterprises for improperly disposing of machines.⁶² Gartner finds that storing computer equipment is often the easiest alternative, but it is also the least effective and most costly in terms of total

cost of ownership (TCO). They also find that as enterprises extend the life cycles of their PCs, the sale proceeds are far less than the actual costs associated with disposal and proceeds. Proceeds from sales or profit sharing via asset management companies range from \$25 to \$42. In evaluating the costs of various disposal options, Gartner finds three factors to consider:

- **The per-PC costs**
- **The administrative overhead costs associated with the disposal method selected**
- **The legal and economic risks to the enterprise for improperly disposing of PCs**

The costs to dispose of PCs include those of disconnecting the computer from the network and printers, staging equipment, backing up and sanitizing the hard drives, and, in some cases, reloading the operating system, testing the equipment and processing payments. Other costs include administrative paperwork, packing, shipping, and handling.

Computer disposal is surprisingly expensive. Gartner calculated the costs of six ways that companies can responsibly dispose of computers, including sale to employees (\$136 per computer), donating to charities (\$127 per computer), brokered sale or auction (\$105 per computer), total destruction (\$93 per computer), trade-in (\$85 per computer), outsourcing disposal (\$107 per computer). Donating to charities is currently a relatively costly option, and when Gartner calculated the additional overhead (20 to 40 hours) of locating a suitable nonprofit recipient, it becomes the most costly method of computer disposal.

E-WASTE DISPOSAL COSTS

Within established donation streams, approximately 30% of computer equipment donations are considered e-waste. In other words, these donations cannot be reused or recycled cost-effectively and are, therefore, sent to landfills.

CRT monitors are the biggest e-waste cost factor. Costs for CRT monitor disposal vary according to location. Some states, notably California and Massachusetts, have banned CRTs in landfills, and many local waste management authorities in the country have also banned them. It is now a cost factor for almost all nonprofit refurbishers. In the San Francisco Bay Area, most refurbishers charge at least \$10 to accept monitors to cover their CRT disposal costs. In the rest of the country, approximately 25% of refurbishers charge donors for accepting monitors. Since 2001, most Goodwill and Salvation Army locations have stopped accepting computer donations due to the mounting costs of e-waste disposal.

OPERATING SYSTEMS

Operating systems are necessary to the process of refurbishing computers. In its survey of non-commercial refurbishers at a March 2003 Computers for Schools Chicago conference, CompuMentor found that most computers are donated either with hard drives wiped or without the media and documentation sufficient to reuse the software. One important function of

operating systems is to supply the device drivers necessary to run a computer's essential, underlying programs, such as the graphics card, modem, network card, and sound card.

Nonprofit refurbishers have historically supplied Windows operating systems with their refurbished computers, even though operating system costs have comprised up to 50% of their total refurbishing costs. The cost of purchasing a Windows operating system is approximately \$80.

The previously referenced NERC report also discusses the importance and costliness of operating systems:

In national and regional discussions, providing operating software has consistently been highlighted as essential to a viable reuse market for computers. It is almost as consistently pointed out as one of the significant costs that impact the financial viability of such efforts.⁶³

As discussed in the following section, this cost factor has been significantly mitigated by the Microsoft Authorized Refurbisher (MAR) Program.

COORDINATION AND LEADERSHIP

As mentioned previously, no coordinated, nationally based distribution system for computer refurbishing currently exists in the US. However, in September 2003, the California Electronic Waste Recycling Act of 2003 was signed into law, becoming the first major e-waste legislation enacted in the US. The law will go into effect in the summer of 2004, establishing a \$6 to \$10 point-of-sale fee on all new monitors and TVs sold in California. The revenues from this program will fund a collection system for CRTs and TVs. Noncommercial computer refurbishers are expected to be eligible to function as collection points that will be reimbursed at 20¢ per pound, thus covering some of the e-waste disposal costs that currently hamper this field.

The California Electronic Waste Recycling Act has provided strong incentive for industry members of the National Electronics Product Stewardship Initiative (NEPSI)⁶⁴ to solidify a computer recycling system on a national level. Despite expectations that the NEPSI process would fail completely, the last official meeting of NEPSI stakeholders in February of 2004 did not end in deadlock. The process of devising a national computer recycling system for the US continues.

Industry Developments

In recent years, two important additions to the computer recycling landscape have greatly improved its viability: The Microsoft Authorized Refurbisher (MAR) Program and the Linux/Open Source Movement.

THE MICROSOFT AUTHORIZED REFURBISHER (MAR) PROGRAM

The Microsoft Authorized Refurbisher (MAR) Program⁶⁵ launched in December 2002 as an initiative of Microsoft and CompuMentor to provide Windows 98 and Windows 2000 operating systems to noncommercial PC refurbishers in the United States. The program provides Windows operating systems to noncommercial refurbishers at a handling fee of \$5 per license. Microsoft donates the operating systems and CompuMentor manages the program through its technology donation distribution program TechSoup Stock (<http://www.techsoup.org/stock>). MAR has quickly become integral to the noncommercial computer refurbishing field.

The intent of the MAR program is to increase the number of refurbished PCs distributed to nonprofit organizations, K-12 schools, public libraries, community colleges, and technology access programs that distribute refurbished computers and training to low-income or disabled individuals in communities that traditionally have limited access to technology.

The MAR Program grew out of Microsoft's desire to emphasize the importance of computer refurbishing and reuse in nonprofits and schools as well as for people on the wrong side of the digital divide. Developed in cooperation with existing noncommercial computer refurbishers, the program's original pilot participants were Computers for Schools Chicago, RAFT (San Jose), Per Scholas (New York), OTX West (Oakland), StRUT (Portland), and the National Cristina Foundation (Connecticut).

The impact of the MAR program in its first year has been dramatic. In the 13 months since launch, approximately 250 refurbishers have signed up with the program at steady rate of four organizations per week. CompuMentor estimates that 400 to 500 such programs currently operate in the US with an average capacity of 400 computers per year. On average, MAR has increased participant capacity by approximately 30%.⁶⁶ Also, and perhaps most importantly for the long-term sustainability of this field, the MAR program is the first effort in the country to bring together all noncommercial computer refurbishing programs. Four months after launch, Computers for Schools Chicago hosted the first national conference of MAR refurbishers.

MAR has substantially lowered software costs and permitted noncommercial refurbishers to expand their capacities, as exemplified by The People's Resource Center. This organization supplies computers to low-income families in DuPage County, Illinois. Frank Goetz, Executive Director of the program, reported on the positive impact that MAR has had on his program's operations:

Prior to this year we were refurbishing 600 computers a year, using the Linux operating system. When the Windows 98 licenses became available in January, two things happened: (1) the demand for our computers by low-income families in DuPage County started accelerating, and (2) our capability to refurbish and support these computers correspondingly increased. We are now refurbishing 1,000 to 1,100 computers per year. We are delighted with these developments, and not too surprised by them.

Approximately 50% of computers refurbished by the MAR Program go to schools, 27% go to nonprofits, and 23% go to low-income families. The average cost of acquiring a computer from a MAR refurbisher is \$49, although 55% of MAR refurbishers do not charge any fees for their refurbished computers. Computers for Schools Chicago, ClearLink in Michigan, and The Computer Recycling Center in the San Francisco Bay Area are the largest MAR refurbishers with capacities at approximately 10,000 computers per year.

The MAR program has a sister program operated by Microsoft Education called the Fresh Start program. Fresh Start supplies Microsoft Windows 98 and Windows 2000 licenses to US-based K-12 schools at no cost for computers that originally ran on Windows operating systems.⁶⁷

THE LINUX/OPEN SOURCE MOVEMENT

The Linux/Open Source movement is another major area of interest among noncommercial refurbishers. Many noncommercial computer refurbishers use Open Office or 602 PC Suite on their computers, if for no other reason than the MAR program does not yet supply an office suite. Several people in the Linux/Open Source refurbishing community are also interested in building Linux-based "thin client" computer networks in which a server runs the programs and the PCs simply display the video and accept keyboard and mouse input. Because the server runs a version of Linux, the software is free, virus issues are minimal, and maintenance time is substantially reduced. Only the server needs to be a fairly current computer, while the clients can be low-end Pentium Is. Companies like Academic Computing Environments, and Symbio Technologies in New York are promoting thin client Linux solutions. Efforts to develop Linux thin client solutions have mostly targeted schools, but there is also active interest among Community Technology Centers.

Perhaps the most prominent Linux/Open Source refurbishing project in the country is Free Geek in Portland, Oregon. Free Geek was founded and is directed by Oso Martin, a prominent figure in the Open Source community. The program has a yearly output of 1,200 computers with an expectation to supply 3,000 computers next year. Free Geek has developed a custom Debian-based Linux desktop OS called Freebox that functions much like Windows. Free Geek has major foundation support from Meyer Memorial Trust, which is dedicated to developing Open Source software for nonprofits via a Free Geek program called Collaborative Technologies.⁶⁸ Free Geek also has a sister organization in rural South Bend, Indiana (Free Geek Michiana) and another in rural Pennsylvania (Free Geek Penn). Other nonprofit programs are interested in opening Open Source refurbishing projects in Moab, Utah; Bronx, New York; Columbus, Ohio; and Seattle and Olympia, Washington.

The San Francisco Bay Area's Alameda County Computer Resource Center is a very large non-commercial Linux-based computer recycler. Another is Low Income Networking and Communication (LINC) Project in New York City. Thomas Webb's refurbishing program at Pueblo Community College in Colorado is a very good Linux project based at a junior college. The Computerbank Project⁶⁹ in Australia and Access to Recycled Technology⁷⁰ in England are prominent international Linux refurbishing programs.

The Open Source Development Lab (OSDL)⁷¹ in Beaverton, Oregon is an important nonprofit open source research and development project. It was founded in 2000 with sponsorship by Computer Associates, Fujitsu, Hitachi, HP, IBM, Intel, and NEC. Membership in OSDL also includes most of the other large high tech firms interested in promoting Linux. MIT Media Lab Open Source Project⁷² is another important R & D effort. This project is aimed at having students design, prototype, and document open-source solutions for real world challenges in developing countries.

Computers for Schools Canada

Computers for Schools Canada has quietly and thoroughly demonstrated the potential of non-commercial computer refurbishing. CFS Canada is the largest and most developed noncommercial computer reuse system in the world. The program was founded and is still run by Wayne Tosh who works for Industry Canada, the equivalent of the US Department of Commerce.

CFS Canada has 69 computer refurbishing programs distributed throughout the Canadian states and provinces. The program has placed 415,000 computers in the last 10 years and currently supplies 25% of Canadian school computers annually, about 80,000 computers.⁷³

The program has progressed more than any US program as far as integrating reusable computers with the public school system to improve student access to computers. CFS Canada plans to stabilize the mix of equipment at 15% new computers, 50% newer off-lease computers, and 35% older refurbished computers to get to a 5:1 student:computer ratio in one year, and a 3:1 ratio in four years. CFS Canada has also recently opened up its computer distribution to Canadian nonprofits.

Elements of the program's integrated computer refurbishing system:

- **A pro-bono shipping arrangement with the Canadian National Railway and Sears Long Haulage. (Shipping is a major cost factor in US computer recycling.)**
- **A quality control system to ensure that all distributed computers are working properly. Canadian refurbisher programs are starting to acquire ISO 9000 certifications.**
- **A component trading exchange (hard drives, keyboards, monitors, mice, etc.).**
- **A national volunteer arrangement with Telephone Pioneers, the largest industry-related volunteer organization in the world.**
- **Large donation arrangements with Canadian corporations.**
- **An arrangement with Microsoft for donated operating systems.**
- **A free Web site that assigns the market value of donations for tax purposes.⁷⁴**
- **Integration and involvement in the Canadian school curriculum.**
- **Integration with Connecting Canadians, the national digital divide initiative that operates nearly 9,000 public computer access centers in libraries and other public places.**
- **A budget for ongoing public awareness campaigns to keep donations and volunteerism active in the project. The program also organizes letter campaigns in which school children write to donor companies and politicians.**

Wayne Tosh reports that demand for CFS Canada computers has exceeded supply to date, and he expects steady, continued growth of the program in the foreseeable future.⁷⁵ CFS Canada is also mentoring the creation of similar programs in Colombia, Kenya, Jordan, Argentina, Dominican Republic, Mexico, Paraguay, Chile, Angola, and other countries.

Snapshots from the Field

Although the secondary computer market is still relatively young and unstructured, computer reuse has been going on in the US since the mid-1980s when the original 8088 Intel processor personal computers were being discarded in favor of 286 and 386 PCs. During the early years of personal computing, hardware and software improvements were dramatic and the three- to four-year initial lifespan of personal computers quickly became the norm. DOS command line computers seemed obsolete by the mid-1980s and became easy to acquire as donations.

ORGANIZATIONS

During the 1980s, many small garage computer recycling projects cropped up. Some of these projects developed into commercial programs and some into noncommercial ones. Jim Lynch of CompuMentor ran a small noncommercial computer refurbishing program for three years to supply the homeless education computer labs he was building in the Bay Area. That type of program is a strong impetus for noncommercial computer refurbishing: to satisfy the hardware needs of a low-income school or nonprofit program that is just getting off the ground. Nonprofit organizations sponsoring computer refurbishing work have on average been in existence twice as long as commercial computer refurbishing companies.⁷⁶

NATIONAL CRISTINA FOUNDATION

The National Cristina Foundation (NCF) was founded in 1984 by Bruce McMahan and Yvette Marrin. Headquartered in Connecticut, NCF is the oldest noncommercial computer reuse project in the country, one of six matching or intermediary services currently operating in this field.⁷⁷ NCF matches computer hardware donations to a grassroots network of thousands of nonprofit organizations, public agencies, and schools that serve people with disabilities, students at risk, and economically challenged persons in all 50 states and internationally. It continues to expand its distribution areas steadily and to establish strategic partnerships across the technology industry such as with Dell Computers and the Computing Technology Industry Association (CompTIA).

DETWILER FOUNDATION

The Detwiler Foundation was an ambitious nonprofit computer reuse project that closed its doors in the spring of 2000.

The Detwiler Computers for Schools Program was a nonprofit organization founded 1991 by John Detwiler, an entrepreneur who had founded an investment firm and invented plastic snow chains for car tires. The Detwiler Computers for Schools Program essentially solicited old computers from businesses, had them refurbished primarily by state prison inmates, and then provided them to schools. At its zenith in 1997, the program supplied 16,000 computers per year to schools. The largest supplier of computers to the California schools, the Detwiler Foundation had donation centers in 31 states and partnerships with the California, Minnesota, and Hawaii

Departments of Corrections as well as Intel, Microsoft, and Pacific Bell. The Detwiler Foundation testified in front of Congress to help pass the Federal New Millennium Classrooms Act, secured significant government and foundation funding, and was referenced in numerous magazine and news stories throughout the late 1990s. In addition, in his State of the State address in 1997, California Governor Pete Wilson described the Detwiler Foundation as a model program.

The Detwiler Foundation was about as successful as any nonprofit project can be, but in this case, it may have been too successful. By 1997, the Detwiler Foundation had so dramatically elevated its profile that it came under public criticism for delivering non-working computers, selling computers inappropriately, inflating their statistics, and for John Detwiler's \$115,000 annual salary. By that time, 60% of California's new \$10 million Computer Refurbishment Fund was devoted to the Department of Corrections prison refurbishing programs to upgrade computers distributed by Detwiler. The project began its decline when state officials accused Detwiler of charging schools for the donated computers, and then terminated the relationship. By 1999, the project was under investigation by the State of California Attorney General and then, despite a restructuring attempt, closed in April of 2000.

The Detwiler Foundation was an entrepreneurially conceived and operated nonprofit. The project grew quickly and it made big public deals on which it apparently could not deliver. John Detwiler ably sold the vision of refurbished computers as the solution to the digital divide to large companies and state governments, but sold the computers rather than donating them as was apparently promised to the California Department of Corrections. Detwiler promoted prison-based computer recycling and refurbishing, which is still a hotly debated issue. In a time when California ranked 50th among US states in the number of computers per students in classrooms, Detwiler sought to harness the wasted resources of discarded computers and prison labor.

In 2000 and 2001, press coverage of the noncommercial computer refurbishing movement was often suffused by a vague cloud of public suspicion for malfeasance and of attempts to palm off useless high tech garbage to schools. Some state prison refurbishing programs still exist, but the focus of prison computer recycling has shifted to the large industrial scale program run by UNICOR Prison Industries. UNICOR computer recycling plants employ over 800 inmates in seven plants around the US to refurbish, disassemble, de-manufacture, and shred plastics, metals, and glass.

One probable legacy of Detwiler is that its home territory, the San Diego area, is one of the most robust noncommercial computer recycling areas of the country. The Technology Training Foundation of America is a successful program from the Detwiler era and the San Diego Futures Foundation started in 1999 and is now one of the largest and most successful public/private model computer reuse programs in the country. SDFR receives over 1,000 surplus computers annually from local high tech companies as part of a large government IT outsourcing contract. They refurbish Pentium-level equipment and distribute it to schools and nonprofits at no cost. San Diego is also home to the Pangea Foundation, the MAAC project, AFCEA, and other refurbishing programs.

COMPUTERS FOR SCHOOLS (CFS) CHICAGO

Computers for Schools (CFS) Chicago is certainly the most direct descendant of the Detwiler Foundation. CFS Chicago was incorporated as a nonprofit in 2000 by Willie Cade, just as the Detwiler Foundation was closing operations. Willie Cade is a former management consultant who, like many people in this field, began refurbishing computers out of his garage. In the wake of Detwiler, CFS quickly reorganized the network of refurbishers assembled by Detwiler and began operating a national toll free phone number for equipment donations. The program has also carried on the policy work started by Detwiler, most recently organizing noncommercial refurbishers to get the Federal Child Pact Act and New Millennium Classroom Act renewed. These measures encourage Federal donations of computers to schools and nonprofit refurbishers, and increase the tax deduction value of computer donations to schools and noncommercial refurbishers.

Like the Detwiler Foundation, CFS Chicago is eager to make a national impact in computer reuse. Unlike Detwiler, it is a self-contained program that does its own refurbishing rather than relying on prison or other refurbishing programs. In addition, CFS Chicago is very clear about its business model. It sells its computers to school districts to cover the costs of paid bench technicians, who spend an average of 2.3 hours per computer to get the computers in warrantable condition.⁷⁸ It is quite legal for nonprofit refurbishers to sell their computers to cover their costs, as long as they don't abrogate contracts, as Detwiler was accused of doing. CFS Chicago offers a one-year parts warranty on all of their computers, and installs and networks equipment in schools. It is now one of the three largest noncommercial refurbishers in the country and has opened another large program in Philadelphia.

This hands-on approach to the work is based on Willie Cade's working assumption that refurbished computers must compete with new computers. Fail and return rates must be comparable to those of Dell, HP, and IBM.

COMPUTERS FOR LEARNING

The Computers for Learning (CFL) Program is a US government program within the General Services Administration. Its mission is to provide used government computers to schools and to some educational nonprofit organizations. It was created in 1996 as a result of Executive Order 12999, Educational Technology: Ensuring Opportunity for All Children in the Next Century. The CFL program is essentially an online matching service⁷⁹ in which schools and eligible educational nonprofit organizations register their computer needs. When federal agencies are seeking places to donate used computer equipment, they search the database to find recipients who are good matches.

The volume of computer donations via the CFL program was 12,000 in 2002, and will be over 20,000 this year. Over 10,000 schools and educational nonprofit organizations have registered to participate in the CFL program. Nearly 600 property managers representing 36 federal agencies use the CFL Web site. The program does not track the numbers of schools receiving

computers. The program distributes 486s, Pentium Is, and Pentium IIs. The CFL program allows schools and educational nonprofit organizations to request “functional” and “nonfunctional” equipment. Any computer transferred as “functional” has a working operating system.

At this point, Executive Order 12999 does not allow the government to donate used computers to noncommercial refurbishers or recyclers, but that may change if the Child Pact Act legislation becomes law. According to CFL officials, the number of available government computers is expected to decrease as the government continues to become smaller and as agencies move to leasing computer equipment. To address this issue, the General Services Administration expanded the CFL program in February 2004 to allow private sector companies and private individuals access to the CFL Web site.

SCHOOL-BASED PROGRAMS

A significant amount of computer refurbishing occurs in schools. The StRUT programs date from 1995, and although the flagship program in Portland was forced to close in August 2003 due to state budget cuts, it has recently reorganized and is poised to resume operations. StRUT programs still operate in Arizona, Georgia, and California’s Silicon Valley. In addition, major school refurbishing programs operate in Delaware and Maryland and the Dell TechKnow program supplies 12 school districts around the country. Approximately 20% of MAR participants are school-based programs and MAR’s sister program, Fresh Start, serves a large number of schools.

INTERNATIONAL PROGRAMS

A number of US programs supply computers overseas. The largest is World Computer Exchange headquartered in Boston, but there is also the Virtual Scavenger Project in Indianapolis, World Care in Tucson, Computers for the World in Washington DC, and many more. Large organizations like the YMCA, Easter Seals Society, National Urban League, Habitat for Humanity, United Way, Boys and Girls Clubs of America, and Special Olympics also sponsor international refurbishing programs.

INDIVIDUALS

So far, this study has focused primarily on the market issues related to the noncommercial computer reuse field. This area of human endeavor, however, is not all about profit, loss, viability, and environmental diversion. The field has people doing heroic work, often at little or no pay, and it generates significant social capital. This is a social movement into which thousands of people pour their time and passion.

GARAGE RECYCLERS

Not much is known about the number of people around the country informally collecting old computers, fixing them up, and getting them back in action. Gene Schmidt from Scottsdale Community College in Arizona has been following the growth of “garage recyclers” for sever-

al years. Gene, himself an experienced garage recycler, reports that garage recyclers are likely to continue to play a major role in transferring four- or five-year-old computers to families, CTCs, and nonprofits who can use them for job training, academics, and outreach for shut-ins isolated by disability, age, or poverty. Gene maintains that a kind of altruistic chemistry happens in a personal exchange between a computer donor with an urge to see a perfectly good computer find a new home and a refurbisher with a feel for the value remaining in an abandoned computer. Gene describes it this way, “the transaction between an individual donor and a garage-level recycler is more like giving extra ripe tomatoes to a neighbor than like getting the resale value out of a now unused lawnmower.”

Gene cites the example of Michael Dare-Gentile’s program, One River Recycling,⁸⁰ based in New Jersey. Mr. Dare-Gentile explains how he got into garage recycling:

My wife and I returned from our first trip to Jamaica, and having visited an orphanage in the foothills of the Blue Mountains, realized that they might be able to use the old Apple IIe we had stored away in the basement. Due to security reasons at the home they couldn’t. I went searching the net. I found a Web site in Helsinki. He had great links to Jamaica and I followed a few and stumbled across a listing from a PC volunteer who was in Jamaica and looking for used computers.... The rest is history.

Based on Michael Dare-Gentile’s firsthand view of the need in Jamaica, and finding someone there to receive the computers, he now makes collection trips in his van as far as New York City from his tiny farm in southern New Jersey. He completes computer refurbishing work out of his barn.

MAUREEN WILSON AT KIDANGO

A bit up the organizational development ladder from the garage is Maureen Wilson of Kidango in Fremont, California. Kidango is a nonprofit that runs childcare centers for low-income, homeless, and AIDs-afflicted children and infants in the southern part of the San Francisco Bay Area. Maureen went to work at Kidango three years ago as a temporary worker in the agency’s administrative office. When the agency’s then tech support company charged Kidango \$300 to come out and swap out a \$10 mouse, she was quickly recruited to be the organization’s accidental computer techie because she had the knack for making computers behave. Her sole training in this area was one Mac repair class in 1996.

Becoming familiar with the state of Kidango’s computers and also becoming aware of teacher requests for computers in the childcare centers, Maureen quickly took it upon herself to solicit on Kidango’s Web site for better computers. As the computer donations started coming in, Maureen began working nights and weekends to establish an operation to refurbish the donated equipment. For five months she put in an extra 45 hours per week of volunteer time in addition to her full-time schedule. At the end of that time, she had swapped out the older administrative computers and also supplied 35 teacher computers and 20 classroom computers.

She now works on the project about 10 hours per week, still as a volunteer, cycling older

equipment out and supplying 50 additional computers to the childcare centers. She has a couple of boxes of spare parts, picks up donations in her car, stores computers in her carport, and occasionally uses Kidango's small work room. She also answers the switchboard phones.

When asked what drives her to do all this work, Maureen says it's the teachers. She's doing it for them. Maureen is proud to be a true-blue computer geek, more interested in than frustrated by computer problems. She is not afraid of any computer problem and is not afraid to ask for volunteer help or donations. Maureen constantly searches for donations, from cruising yard sales and grocery store bulletin boards to making calls to Fujitsu.

BRUCE BUCKELEW AT OTX WEST

Up the ladder a bit more is Bruce Buckelew at Oakland Technology Exchange (OTX) West. Bruce is a retired IBM engineer who began doing volunteer tech support in an Oakland school near his home 12 years ago. The poor quality and lack of equipment in this inner-city school caused him to start a refurbishing operation in the basement of Oakland Technical High School. Bruce is one of the veterans of the field, running a 2,500 computer per year refurbishing program. He is still an unpaid volunteer, but has three full-time staff members who run the administrative office and production functions. OTX West is a large model program that operates out of an 18,000 square foot warehouse and attracts visitors from all over the country to see how this work can be done optimally.

OTX West supplies computers to the Oakland schools and to the families of low-income students in the schools. They produce three products with different arrays of software appropriate to their users:

- 1. Home Windows computers for middle school and high school students and their families.**
- 2. Home New Deal-based Pentium I computers for middle school students and their families.**
- 3. Windows Pentium II computers for classrooms, teachers, and labs.**

The program also has a CTC training lab that families must use before they can acquire their computers. Bruce works 40 to 50 hours per week and has adult job training technicians working the benches to refurbish the approximately 200 computers that the program produces each month. He is also actively involved with CTCNet^{BI} to promote best refurbishing practices among community technology centers interested in starting computer take-home programs. OTX has fail rates at or below those of Dell and recipients can exchange a computer for any reason and get another one. OTX West can provide this level of service because of their standard configurations.

Conclusion and Next Steps to Develop the Field

“Charity recycling is a flower that has not bloomed yet.”

MARK MANZANO,
METECH INTERNATIONAL 2003

To date, the noncommercial computer refurbishing field has been mostly discounted as a marginal part of the recycling industry. Indeed, the entire computer reuse field can be described as declining due to the steadily dropping prices for new PCs and high US labor costs compared to world standards.^{B2} This decline may be occurring in commercial computer remanufacturing, as was concluded in the NERC study and from Hargadon Computer’s experience. We have found, however, that the noncommercial computer refurbishing field is alive and well, largely because it is not profit driven. Noncommercial refurbishers must make ends meet, but they also double-purpose their programs to provide professional hands-on training to low-income people. This focus on social purpose helps these noncommercial refurbishers access support through government initiatives and philanthropic funding. Noncommercial programs also rely on volunteerism, which lowers operating costs considerably although it may not be the most organizationally efficient way to refurbish computers.

As the computer market has matured, opportunities have increased for viable computer reuse and refurbishing. The vast majority of computers now discarded are Internet-capable and able to perform most, if not all, of computerized functions needed by nonprofits and schools. This discarded equipment could be highly valuable in helping to address the digital divide, which still exists to a significant degree in the US.

CompuMentor plans to build on this body of research and to continue hands-on projects to deepen public knowledge in the computer reuse and refurbishing field. CompuMentor also is coordinating a noncommercial computer reuse conference in cooperation with Computers for Schools in the Fall of 2004 that will focus on NCR industry standards. Much of this work is guided by nine factors that CompuMentor has determined to be critical to building this field’s capacity:

- **Increase the computer reuse and refurbishing field’s visibility.**
- **Develop the community of noncommercial computer refurbishers for information sharing.**
- **Expand the MAR program to include other needed resources for noncommercial computer refurbishers.**
- **Create a standards or accreditation body that sets practical warranty, fail rate, and data removal standards.**
- **Encourage the creation of large-scale donation or intermediary mechanisms to distribute computers to refurbishers to make corporate donations much more cost effective.** This approach also answers the need that refurbishers have for a more consistent supply of useful donations.

- **Provide noncommercial computer reuse and refurbisher representation to help the National Electronic Product Stewardship Initiative (NEPSI) create a national computer recycling system.**
- **Identify and develop downstream e-waste disposal options to better close the loop between computer refurbishers and recyclers.**
- **Foster the transfer of knowledge and resources around computer refurbishing to developing countries.** While a significant portion of the US population still does not have access to computers, the need is much deeper in Africa, Latin America, and Asia. A number of projects are beginning to work with developing countries, where typically well under 10% of the population has access to computers. Considerable potential exists to bring the reuse and refurbishing infrastructure developed in the US to the benefit of other countries.
- **Advocate for federal legislation to amend Section 170 of the US Federal Income Tax Code so that it will provide full or partial fair market value to computer donations from businesses.** Currently, there is virtually no uniform tax deduction benefit for US businesses to donate fully depreciated computers to charities and schools.

We have found significant demand for good working low- and no-cost computers among schools, nonprofits, low-income families, and microenterprise businesses—when price and quality thresholds can be met. There is currently some skepticism among these groups as to the quality and usefulness of recycled and refurbished computers, but if basic quality standards can be adopted by the NCR field, we believe that demand for three- and four-year-old computers will increase both in the US and in developing countries.

Major corporations, including Microsoft, Cisco, Dell, General Motors, Applied Materials, and trade groups like the Computing Technology Industry Association have expressed strong interest in supporting efforts to develop this field. There is immense potential in middle schools, high schools, community colleges, and universities for using computer refurbishing to supply computers to schools, and also to teach vocational and environmental education. The Goodwill and Salvation Army programs across the country are very interested in getting back into computer reuse and, with the passage of the California e-waste law and good movement in the NEPSI process on the part of Dell and HP, they may well be able to get their e-waste costs covered so they can reenter the field. Finally, there is an army of environmentally concerned technologists that comprise the garage recycler movement, the community technology movement, and the nonprofit refurbisher movement. It is hard to quantify the passion and commitment of these people, but it has been a great privilege this past year to meet and work with a number of them.

In sum, despite findings that no uniformly substantial tax benefit exists for businesses to donate computers and that donating computers is currently costly and difficult, we believe that the non-commercial computer reuse field possesses excellent growth potential in the US. Developed well, this field could divert significantly greater amounts of discarded material from landfills and also help remedy the digital divide both in the US and, potentially, the rest of the world.

Appendix I

REFURBISHER SURVEY

21 respondents, all data collected by phone or in person.

Note: Due to the lengthy and qualitative nature of survey responses, only survey questions are provided below.

Name of organization: _____

Contact person: _____

Phone: _____

Email: _____

Address: _____

Date of contact: _____

OVERALL MARKET

1. What is the yearly budget of your organization?
2. How many paid staff do you have? How many volunteers?
3. How many computers do you estimate are donated to you per year?
4. What percentage of hardware donations do you estimate come from:
Individuals
Businesses or corporations
Government
5. How many computers per month do you supply to nonprofits, schools and low-income people?
6. What is the minimum type of computer(s) that you accept (working or nonworking Pentiums)?
7. Is your supply of computers greater, or is the demand for them by schools, nonprofits, and individuals greater? By what percentage would you estimate?
8. What, if anything, do you charge recipients per computer (say a basic Pentium I or II)?
9. What two or three things most impede the number of computers you supply to schools, nonprofits or low-income people?
10. What would you estimate your capacity for supplying computers to be in the next 3-5 years?

DONOR RELATIONS AND CONCERNS

- 11.** What donation sources do you find most useful (e.g., large corporations or individuals)?
- 12.** What do your donors report as the main incentive(s) for donating computers to you?
- 13.** How much, if anything, do you charge donors?
- 14.** What percentage of donors do you estimate ask for a donation letter for tax deductions?
- 15.** Are there any other ways that you compensate your donors?
- 16.** Do you offer any data security guarantees to the donors (wiping hard drives)? What percentage of donors do you estimate ask for this?
- 17.** What percentage of donors do you estimate leave their software on the computers?
- 18.** What percentage of donors do you estimate supply all the documentation necessary for you to pass the software on to nonprofit, school, or low-income individual recipients?
- 19.** How do your donors report that they find out about you?

RECIPIENT RELATIONS AND CONCERNS

- 20.** Please estimate the percentages of your recipients:
 - Schools
 - Nonprofits
 - Individuals
 - Access programs like libraries or other government agencies
- 21.** What is your application process for schools, nonprofits, and individuals to get computers?
- 22.** How long, on average, do applicants need to wait to get computers?
- 23.** What is your estimated cost to refurbish an average computer?
- 24.** What is your current fail rate and/or return rate for computers you refurbish? (Dell is 7%)
- 25.** Are you able to offer any kind of warranty (90 days) or “after sales service” or support?

ENVIRONMENTAL CONCERNS AND GENERAL QUESTIONS

26. How many computers do you need to get donated on average to get one working computer (e.g., 3 to 1)?
27. What components (like mice, keyboards, RAM, hard drives, etc.) do you mostly need to buy to refurbish your computers?
28. What are your yearly costs for e-waste disposal?
29. What two or three things are your most difficult problems in regard to e-waste?
30. Can you think of anything that CompuMentor, the Microsoft Authorized Refurbisher (MAR) Program and TechSoup can do for your organization to increase your capacity (e.g., market the techsoup.org recycler listings better to bring you more donations, supply other software through MAR, add content on TechSoup for e-waste disposal, funding sources, etc.)?

Appendix 2

BAY AREA BUSINESS SURVEY

67 respondents, administered online

1. Company name

TOTAL RESPONDENTS	65

2. The county where the company is located

TOTAL RESPONDENTS	64

3. Number of employees

NUMBER OF EMPLOYEES	% OF RESPONDENTS	# OF RESPONDENTS
1 – 100	29.7%	19
100 - 1,000	23.4%	15
1,000 - 10,000	31.2%	20
10,000 - 50,000	10.9%	7
50,000 or more	4.7%	3
TOTAL RESPONDENTS		64

4. How they heard about this survey

TOTAL RESPONDENTS	54

5. How do you currently dispose of computers?

DISPOSAL METHOD	% OF RESPONDENTS	# OF RESPONDENTS
We throw them out	15.9%	10
Send them to a commercial recycler that wipes data and recycles the computers	46.0%	29
Our IT department stores them and uses the parts	41.3%	26
We donate them to schools and nonprofits	54.0%	34
We donate/sell them to employees	36.5%	23
We resell them to the public or to a secondary market company	11.1%	7
We send them back to the manufacturer to trade in for new computers/credits	14.3%	9
Don't know how we dispose of computers	4.8%	3
Other (see below)	17.5%	11
TOTAL RESPONDENTS		63

- Post on internal reuse web-tool (like an internal eBay tool).
- I set up a nonprofit that takes the surplus computers that I do not reuse internally and provides them to schools and nonprofits. After recapture of assets, 100% recycled.
- Currently, we lease our computers.
- Return leased PCs to vendor.
- In 2003, we are starting a recycling program.
- We donate them to a refurbisher in Oakland for recycling/reuse.
- Hold on to them -- waiting to take to recycler.
- Our outsourced IT provider (IBM) removes them and recycles them.
- Haven't had to deal with the issue yet.
- I believe we lease from IBM...so we just return them.
- We are a commercial recycler/asset recovery contractor.

6. If you do donate a percentage of your computers for reuse by nonprofits, schools, etc., what percentage is this?

TOTAL RESPONDENTS	41

7. How many computers do you currently dispose of each year?

COMPUTERS DISPOSED OF	% OF RESPONDENTS	# OF RESPONDENTS
0 to 50	50.0%	31
50 to 100	11.3%	7
100 to 500	21.0%	13
500 to 1000	6.5%	4
1,000 to 3,000	6.5%	4
Above 3,000	4.8%	3
TOTAL RESPONDENTS		62

8. What is your refresh cycle?

REFRESH CYCLE	% OF RESPONDENTS	# OF RESPONDENTS
Every year	3.3%	2
Every 2 years	10.0%	6
Every 3 years	30.0%	18
Every 4 years	13.3%	8
More than 4 years	8.3%	5
No set policy	35.0%	21
TOTAL RESPONDENTS		60

9. What is your current cost for computer disposal per computer?

COST FOR COMPUTER DISPOSAL	% OF RESPONDENTS	# OF RESPONDENTS
\$0 - \$25	74.1%	40
\$25 - \$40	22.2%	12
\$40 - \$75	0%	0
More that \$75	3.7%	2
TOTAL RESPONDENTS		54

10. How important are each of the following factors for your company with regard to computer disposal?

	VERY IMPORTANT	IMPORTANT	SOMEWHAT IMPORTANT	NOT IMPORTANT	RESPONSE AVERAGE
Keeping costs down	52% (31)	37% (22)	12% (7)	0% (0)	1.60
Destroying company data on discarded computers	84% (51)	10% (6)	5% (3)	2% (1)	1.25
Keeping discarded computers out of landfills	62% (38)	23% (14)	8% (5)	7% (4)	1.59
Donating to schools and charities (philanthropy)	33% (20)	40% (24)	20% (12)	7% (4)	2.00
TOTAL RESPONDENTS					62.00

11. How important are each of the following factors for your company with regard to increasing your incentive to donate your working computers to schools and charities?

	VERY IMPORTANT	IMPORTANT	SOMEWHAT IMPORTANT	NOT IMPORTANT	RESPONSE AVERAGE
Selling computers to recover costs	9% (5)	21% (12)	21% (12)	49% (28)	3.11
Monetary incentives (i.e., tax benefits)	5% (3)	30% (17)	25% (14)	40% (23)	3.00
Increasing the profile of your company as a corporate citizen	14% (8)	50% (28)	21% (12)	14% (8)	2.36
Keeping discarded computers out of landfills	54% (30)	23% (13)	16% (9)	7% (4)	1.77
More convenient donation options	31% (17)	51% (28)	7% (4)	11% (6)	1.98
TOTAL RESPONDENTS					57.00

12. Finally, could you imagine (or have you experienced) any attribute of a computer re-use program that would surely cause you to opt-out from participating (i.e., “I would opt out if I didn’t get to choose who my computers go to.” or “If I don’t have verifiable proof that all the company data has been erased”, etc.)?

- Making sure data is erased is important. Convenience is also important.
- Lack of verification that all corporate data would be removed.
- 1. HIPAA Requirements 2. Costs 3. Administrative hassles, etc.
- Company data must be erased. Any and all Federal regulations must be met. Donating company must be free of any and all liabilities. Asset must be legally transferred. Software licenses not to be included.
- Making sure that computers do not end up in Taiwan, Vietnam, China where merchants recycle the parts for local markets.

- Would opt out if re-use program couldn't pick up surplus in timely manner. (We need companies that can pickup FROM us. We have no way to store in large quantity/deliver surplus.) Would opt out if re-use program charged to pick up surplus.
- Donation streams. Proof of destruction of company data. How a nonprofit is held accountable to proper disposal. Providing service for products.
- It would be our IT department's ultimate choice on who these computers would go to.
- We try to always be sure that whoever receives a computer will likewise give their best good faith effort to see that it gets 100% recycled at final disposition.
- I would need verifiable proof of data destruction. I would need the computers to go to non-secular organizations. I would need the computers to not have minimum requirements, such as support, licensing, or minimum hardware specifications.
- I would opt out if the data were not erased or if the location were not convenient.
- Opt-out if re-use program not able to "ready" computers for use by recipient schools/agencies; guarantee that company data completely erased; prove computers go to legitimate school/charity.
- I would opt out if I were not assured that the equipment would end up in the hands of schools or charities. Main concern would be that they are picked up and then resold for profit.
- More likely to donate to a nonprofit re-use vs. a parts recycler. Would opt out if it were likely a large percentage was going to landfill.
- If the company can't obtain verifiable proof all company data has been erased from hard drives, etc. and if the company couldn't provide verification that all components of the system and monitor are recycled.
- Data being erased is critical.
- If I don't have verifiable proof that all the company data has been erased.
- No comment.
- I can imagine many causes for opt-out. We desire to share computing access with local children & our employees as well as making sure our data is securely deleted.
- We definitely need to be 100% all employee data and licensed software had been scrubbed from any computers recycled. Also, we are very concerned about the types of agencies that receive our donated computers. There cannot be any conflict with our basic policies on who is eligible for a donation from BEA.
- I would opt out if the time and expense of shipping computers to schools or charities was prohibitive.
- I would opt out if I didn't have confidence in the organization running the re-use program; i.e., that they were actually donating the computers to worthwhile organizations and that the program was being run efficiently.
- Protection of company intellectual property and data is a real concern in terms of where used hard drives end up. Environmental issues are critical as well. However, at Solelectron we perform asset recovery services for our customers, so we are keenly interested in ways we can add value to the process while satisfying the growing requirements (e.g., WEEE) for recycling, reuse, etc.
- I wouldn't want the computers to go to an organization that couldn't afford to dispose of them properly.
- If I don't have verifiable proof that all the company data has been erased.
- Question 10 is not pertinent as our supplier deals with this. Q11: data security is vital and if our supplier caused us to doubt it, we would be concerned and would take action.
- None.
- No.

- Recycler is reputable with a proven track record. Recycler must be “open” for audits. Recycler must be very “secure” and provide certificates of “proper” disposal. Recycler must provide a certificate certifying that all data has been removed/destroyed and have the technology, software and equipment to do this including the destruction of information on diskettes and CD’s. Recycler must have established business plan so that the “life cycle” of any e-“resources” (waste) can be tracked and verified Would be desirable if the company were 9001 or 14001 certified. Recycler should have signed the Basel Accord and show full support of the Basel Action Network and the Silicon Valley Toxic Coalition. Recycler MUST provide audit trail on how and where he will process the e-resources sent to him. (BC Hydro)
- If I had to pay money to get rid of the computers or to ship them somewhere...or spend a lot of time cleaning the files off.
- None.
- We do not use a direct re-use program, we use a remanufacturer/recycler, who refurbishes machines and sells (at very minimal cost) or gives computers to underprivileged people in impoverished/third world countries throughout the world. They charge us for the recycling on a per pound basis, and then pay us for equipment that they can directly resell to offset costs.
- Sent to foreign destinations for purposes other than school education, refurbished by inmates in China or other repressive regime, refurbished in sub-optimal safety conditions (chemicals...). In other words, a nonprofit who would be able to certify all these attributes of social responsibility would be welcome!
- If it was more trouble than it was worth or security was compromised.
- We lease computers from IBM and HP. So, I don’t think my responses are relevant.
- I would be concerned about data being misused.
- Not being included in the decision process.
- Our policy is not to donate computer equipment. We have tried donation in the past and here are the issues that surfaced. Donation programs usually want better equipment than our company is willing to donate. Most donation programs want the equipment maintained by our company. Our company is concerned about proprietary information. Our company is concerned about the proper disposal of the equipment. If a donation program discards the equipment in an improper manner, our company can be held liable. For these reasons, we choose not to donate equipment.
- All company data must be erased
- Not sure how the schools would dispose of the computers once they are finished with them.

Endnotes

- 1 National Safety Council, "Electronic Product Recovery and Recycling Baseline Report," Washington, D.C., 2002.
- 2 United States Department of Commerce, <http://www.ntia.doc.gov/ntiahome/dn/hhs/TableH2.htm>.
- 3 Gifts in Kind International, "Technology Tracking Study of the Nonprofit Sector," Alexandria, VA, 2001, 8.
- 4 For the purposes of this study, "noncommercial organizations" refers to nonprofit and school-based entities.
- 5 National Safety Council, op. cit.
- 6 Microenterprises are small, usually family-owned businesses capitalized at under \$25,000 per year. They generally open up in the country's poorest neighborhoods to provide goods and services like beauty and nail shops, yard maintenance, small bakeries or delis, lunch wagons, etc. Microenterprises currently account for approximately 16% of Bay Area and US employment.
- 7 Gartner Dataquest, 2003.
- 8 US EPA Plug-In To eCycling, <http://www.epa.gov/epaoswer/osw/conserves/plugin/index.htm>.
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- 10 US EPA Region 9, <http://www.epa.gov/region09/waste/solid/electronics.html>.
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- 13 For the purposes of this study, "noncommercial organizations" refers to nonprofit and school-based entities.
- 14 A comprehensive list of commercial secondary market outlets can be found at <http://www.usedcomputerdealers.com>.
- 15 Cited in IAER report from Plug-In To eCycling <http://www.epa.gov/epaoswer/osw/conserves/plugin/>.
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- 17 Gartner Dataquest, 2004.
- 18 John G. Spooner, "PC shipments to rise in 2004, says Gartner," News.com [http://news.com.com/2100-1003_3-5158374.html?tag=st_rn], February 12, 2004.
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- 24 Bob Tedeschi, "E-Commerce Report: Nonprofit groups are slowly learning the benefits—to service and fund-raising—of being wired," New York Times, May 26, 2003, C5.
- 25 Stephanie Lowell, Les Silverman, and Lynn Taliento, "Not-for-profit management: The gift that keeps on giving," McKinsey & Company, 2001
- 26 Although a small number of nonprofits generate earned income, as Goodwill does with its thrift stores, nonprofits are primarily supported by grants and donations. Approximately \$30 billion, comes from foundations.(Loren Renz and Steven Lawrence, "Foundation Growth and Giving Estimates," The Foundation Center, 2002.)
- 27 United States Internal Revenue Service, 2000.
- 28 Gifts In Kind International, op cit.
- 29 Lowell, Silverman, and Taliento, op. cit.

- 30 TechSoup.org is CompuMentor's technology Web site designed for nonprofits [<http://www.techsoup.org>]. TechSoup Stock is CompuMentor's online donated and discounted technology product program, also designed for nonprofits [<http://www.techsoup.org/stock>]. TechSoup Stock was known as DiscounTech when this survey was conducted.
- 31 Survey indicators were not scientifically derived.
- 32 Survey of Silicon Valley Nonprofit Technology Use, CompassPoint, 2002.
- 33 Gifts In Kind International, op. cit., 10.
- 34 CompuMentor conducted recycled computers installation in four diverse Bay Area nonprofit settings to test the cost of ownership and suitability of typical four-year-old recycled computers now prevalent in the donation stream. We found useability and fail rates similar to new equipment after eight months.
- 35 "Bridging the Digital Divide," presentation, CompuMentor and The Catalyst Alliance/Haas School of Business, May 9,2003.
- 36 This number was derived by multiplying 10.6 million (the number of nonprofit employees calculated by the McKinsey study) by 40%(the percentage of nonprofit workers that the Gifts-in-Kind Nonprofit Technology Tracking Study found did not have computers).
- 37 United States Department of Commerce, op. cit.
- 38 The Bay Area Council is a public policy organization that studies regional economic trends [<http://www.bayareacouncil.org>].
- 39 Catalyst Alliance and UC Berkeley Haas School of Business analysis of 2000 California Census.
- 40 This number is derived by dividing the total number of student families without a PC at home, (estimated by the US Dept of Education National Center for Educational Statistics at 19,380,000) by 1.83, the average family size as calculated by the US Department of Education Digest of Educational Statistics.
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- 48 "Microsoft Extends Windows 98 Support Lifecycle," InfiniSource.com [<http://www.windows-help.net/microsoft/98-lifecycle.html>], January 14, 2004.
- 49 Other estimates suggest that computer hardware has an effective average lifespan of five years.
- 50 This number was calculated by a UC Berkeley Haas School of Business team of researchers, primarily using the statistical abstracts for California schools by county at <http://www.ed-data.k12.ca.us/welcome.asp>. The data collected tabulated the number of students enrolled in nine Bay Area Counties (Alameda, Contra Costa, Marin, Napa, San Mateo, San Francisco, Santa Clara, Solano, and Sonoma counties), dividing enrollment for each county by the number of computers per student in each county, and then subtracting that number from what the number of computers would be with a 4 computers per student ratio. The estimated number of obsolete computers is also added to result.
- 51 More StRUT Program information can be found on their Web site: <http://www.strut.org>.
- 52 This project was lead by Jim Lynch at CompuMentor, Steve Duffy and Charles Nunn at Accenture, Bill Tarr at New Sector Alliance, and Vasu Thirumalai and Kellie McElhaney at UC Berkeley. New Sector Alliance (formerly called Catalyst Alliance) is a nonprofit consulting organization that works closely with Accenture volunteers to help nonprofit organizations perform in-depth business planning and research projects. New Sector Alliance draws on students from major universities like Harvard, MIT, Stanford,

- and UC Berkeley to help with these projects. Our UC Berkeley research team included Winita Lau, Adam Ludwin, Amit Sinha, Deepak Sitaraman, Balaji Thirumalai, and Vasu Thirumalai. Together, the UC Berkeley and Accenture volunteers logged over 500 hours on this project.
- 53 Because this survey was conducted in the San Francisco Bay Area, a preponderance of high-tech companies appear in the sample.
- 54 The responses for "Other" primarily included equipment lease agreements and special arrangements with nonprofits.
- 55 Organizations with school and nonprofit donation rates above 75% included LSI Logic, BC Hydro, Kenneth Cole Productions, City of Livermore, Patagonia clothiers, Sheppard Mullin Law offices, and Haas Jr. Fund.
- 56 Mary Ann Remolador, "Used Electronics Market Study Survey Analysis," Northeast Recycling Council, Inc., August 2003.
- 57 Connecticut, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont.
- 58 Elliot Harkavy, EGH & Associates, interview by author, June 5, 2003.
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- 60 "IAER Electronics Recycling Industry Report," International Association of Electronics Recyclers, July 2003.
- 61 Matthews and Matthews, op.cit.
- 62 Frances O'Brien, "PC Disposal: TCO's Last Surprise", Gartner, Inc, September 2003.
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- 64 Additional information regarding the National Electronics Product Stewardship Initiative can be found at their Web site: <http://www.nepsi.org>.
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- 66 Based on a MAR Program analysis of declared output capacity by refurbishers when they applied to MAR, and how much their ordering has exceeded their originally declared capacity.
- 67 Additional information can be found at the program's Web site:
<http://www.microsoft.com/education/?ID=freshstart>.
- 68 Additional information can be found at the Free Geek program's Web site: <http://www.freegeek.org/collab>.
- 69 Additional information can be found at the Computerbank project's Web site: <http://www.computerbank.org.au>.
- 70 Additional information can be found at the program's Web site: <http://www.a2rt.org>.
- 71 Additional information can be found at the Access to Recycled Technology program's Web site:
<http://www.osdl.org>.
- 72 Additional information can be found at the MIT Media Lab Open Source Project program's Web site:
<http://www.thinkcycle.org/global-dtm>.
- 73 Wayne Tosh, presentation, 2003 Computers for Schools Conference, University of Chicago, March 18, 2003.
- 74 In the United States, Orion Blue Book charges \$4 per quote for this service. See
<http://www.orionbluebook.com/orion/>.
- 75 Wayne Tosh, op. cit.
- 76 Mary Ann Remolador, op. cit., 3.
- 77 The others are Anne Bubnik's Pepsite, the TechSoup.org recycling listings, LA Shares, and the Computers for Schools Chicago.
- 78 2003 Computers for Schools Conference, University of Chicago, March 18, 2003.
- 79 Additional information can be found at the CFL program's Web site: <http://www.computers.fed.gov>.
- 80 Additional information can be found at the One River Web site: <http://oneriver.org/mayne.html>.
- 81 Additional information can be found at the CTCNet Web site: <http://www.ctcnet.org>
- 82 Robin Ingenthron, presentation, Dell Computer Recycling Workshop & Training, Stanford University, October 10, 2003.

