

Product Profile: CRTs— Computer Monitors

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Summary

Cathode ray tubes (CRTs) each contain from 3 to 8 lbs of lead, plus mercury, cadmium, and phosphorous. About one-third of all waste electrical and electronic equipment is from CRTs, yet they represent as much as 80% of the toxic metals in discarded electronics.

Though, most computer monitor CRTs are manufactured in Asia, two Oregon companies manufacture CRT equipment. More than 300,000 monitors are shipped to Oregon consumers each year. In Oregon, the stockpile of CRT monitors—those still within their expected lifespan—could range from 1,865,000 to 2,099,000 units. Using data available from DEQ's waste composition studies and other sources, it is estimated that 5,000 to 8,000 tons of monitors are disposed in Oregon annually.

Though specific data were unavailable, the consultant found several opportunities for recycling computer monitors in Oregon. These included both for-profit and non-profit organizations. They all serve as collection sites that prepare the equipment for refurbishment, donation, resale, or recycling. Each organization has its own end-use markets.

Monitors are sold through many of the same distribution channels as computer CPUs. As a result the consultant found much overlap among the dealers for computers.

Introduction

The goal of this project was to collect data that would inform state decision-makers about the impacts and amount of specific products of interest on the state's environment in order to assist in the development of waste management policies to address these products.

The specific project objectives include:

- Collect specific information about the manufacture, distribution, use, and end-of-life management in Oregon of the specified products.
- Document information about the major companies involved in each stage of the product life cycle.
- Quantify the flow of each product at different stages in their life-cycle in Oregon.
- If possible, document the impact of current product life cycles on the environment in Oregon.

Several factors make cathode ray tubes (CRTs) a solid waste concern. A major component of CRTs is leaded glass, plus mercury, cadmium, and phosphorous. The glass in CRTs contains from 3 to 8 lbs of lead—as much as 25% of the total weight. The Massachusetts Department of Environmental Protection reports that about one-third of all waste electrical and electronic equipment is from CRTs, yet they represent as much as 80% of the toxic metals in discarded electronics. This explains why some environmental management agencies have placed particular emphasis on recovery and recycling for CRTs.

Two of the major uses for CRTs are computer monitors and televisions. These two products occupy significant places in American homes and businesses. Computer monitor sales don't parallel computers exactly, but they have also increased rapidly during the past decade. An important issue in management of older "waste" monitors is the tendency of people to keep older units in storage (e.g., basements, attics, etc.) for extended periods.

The consultant team's research about CRTs involved several strategies. The team investigated product and market information from recent industry and government resources. Numerous reports about computer waste and recycling were researched. Direct contact and interviews were conducted to get a better understanding of the industry and the flow of product into the state. The consultants sought information about the volumes of product flow from industry sources. The interview process worked most effectively to get information about end-of-life management practices. Specific Oregon sales data was not found from any sufficient number of businesses to be relevant.

As shown in the sections that follow, the consultant used national market data to establish estimates of the volumes of CRTs entering Oregon. Estimates of the amounts of computer waste (computers, monitors, and peripherals) generated and disposed have been

established from published data and from waste composition studies completed by Oregon DEQ. The most recent waste data is from 1998. The consultant team investigated the wide array of management options for CRT waste.

Finally, the team prepared an industry profile that details the national and Oregon state companies involved in the manufacture, distribution, and sale of CRTs. The industry profile is summarized in a series of tables and in accompanying appendices.

The same problems that the consultant team found in researching CPUs—confusion about definitions of components and products, the worldwide complexity of the electronics industries, and inconsistency in data collection and use—affected the research objectives regarding CRTs. These issues were complicated further by the use of CRTs in both TVs and computer monitors. Aware of the potential for confusion or double counting, the consultant team sought specific product data wherever possible. Notation is made when only data about CRTs in general was available.

Product flow

To understand the life cycle of products in the state, the consultant team looked at the flow of products in three parts. First is the flow of new products into active use, which is a function of manufacturers, wholesalers and retailers. The second phase of the life cycle is the time products are in active use by consumers. The quantity of products in the state at this phase can be thought of as part of a “stockpile.” The stockpile changes constantly as new products enter and old products exit. The third phase is that time when products reach their end of life and must be managed for reuse, recycling, or disposal.

New Monitors

According to the Microelectronics and Computer Technology Corporation (MCC), there are three groups of electronic displays used in the consumer realm. “The largest displays (>40 inches) are generally in projection format, and thus consume relatively small material volumes; they are also produced in relatively small unit volumes. The smallest displays (<5 inches) are produced in large volumes (over 1.6 billion units in 1998), but tend to be part of larger systems (e.g., appliances, stereos) and so are a relatively small part of the overall material volume. It is in the middle sizes (5 to 40 inches) that the display material volume is a large fraction of the system, and unit volumes are significant.” These are the TVs and computer monitors.

The MCC report claimed that there is for “practical purposes” a one-to-one ratio between the number of computers and the number of monitors in use. The consultant found this to be an oversimplification.

After considering a wide variety of industry and government source materials, the consultant team used a major report completed by Stanford Resources, Inc., on behalf of the National Safety Council as a primary source of information. Known as the “Baseline Report” (for “Electronic Product Recovery and Recycling Baseline Report”), it documents the state of computer recovery and recycling in 1999. The report also provides detailed information on the projected flow and lifespan of new computer products. The Baseline Report is a common source of information for representatives from governmental agencies and non-governmental organizations involved in computer product stewardship.

The Baseline Report estimated U.S. shipments for personal computers in 2000 at 50 million. Table Monitor 1 below shows the Baseline Report’s estimated shipments of CRT monitors. As shown in this table, CRT shipments have not kept pace with the growth in PC sales.

TABLE MONITOR 1: U.S. CRT Monitor Shipments (millions of units)

	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
CRTs	19.5	22.1	24.2	26.1	27.3	27.3	28.4	27.6	26.8	26.1

Source: Stanford Resources, Inc., *Monitor Market Trends*, 1999 (figures for 1999-2003 are forecasts) Includes terminals, workstations, and desktop PC monitors, color and monochrome.

Practical experience suggests that CRT monitors have had a slightly longer lifespan than CPUs. In addition an increasing proportion of new PCs are sold with flat display monitors (non-CRT). According to the Baseline Report: “Shipments of computer monitors based on cathode ray tubes have grown rapidly over the past several years but are forecast to peak in 2000, as liquid display and other flat panel displays increasingly penetrate the market.”

As in previous reports, Table Monitor 2 applies Oregon population data to the U.S. data to estimate the number of computer CRT monitors shipped to Oregon.

TABLE MONITOR 2: Oregon CRT Monitor Shipments (thousands of units)

CRTs	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003
units	234	265	290	313	328	328	341	331	322	313
tons	2340	2650	2900	3130	3280	3280	3410	3310	3220	3130

Computer monitors have been getting larger every year. They contribute nearly 50% of the mass and volume of computer systems, or as much as 25 lbs. Oregon’s new monitor shipments. The table above assumes an average weight of 20 lbs per monitor.

Monitor Stockpile

As in the CPU report, the “stockpile” of monitors refers to the monitors that are still within their average lifespan. The average total lifespan of CRT computer monitors is estimated to be up to 6 to 7 years, now almost double that of the computer CPU. That makes a significant difference. Based on recent sales estimates and their estimated lifespan, the stockpile of CRT monitors in Oregon could range from 1,865,000 to 2,099,000 units—18,650 to 20,990 tons. This figure is greater than the estimated 1.1 million stockpile of PCs in Oregon estimated from data contained in the Baseline Report and described in detail in the CPU report.

As with CPUs, the storage factor is one that frustrates data collection and analysis. One cannot know reliably whether computer monitors in “storage” are still within their normal lifespan or would be considered obsolete. Nevertheless, stored monitors have not entered the end-of-life management stream. It is possible that the longer average lifespan of monitors makes them a better candidate for storage in a home, office, or for reuse and resale than an out-of-date computer. According to the Massachusetts DEP, “A Tufts University report estimates that 75% of obsolete CRTs are in ‘storage’ while the OECD [Organization for Economic Cooperation and Development] pegs the figure at 50%.”

Obsolete Monitors

Using data detailed in the CPU report, the following Table Monitor 3 shows the estimated TONNAGE of obsolete computers, including monitors. Tonnage is used to describe the quantity of obsolete monitors to stay consistent with the measures used in solid waste planning. In this case, obsolete computers are defined as computers that are no longer useable, with PCs describing the CRT and CPU together.

TABLE MONITOR 3: Obsolete Oregon PCs, including monitors, by year (tons)

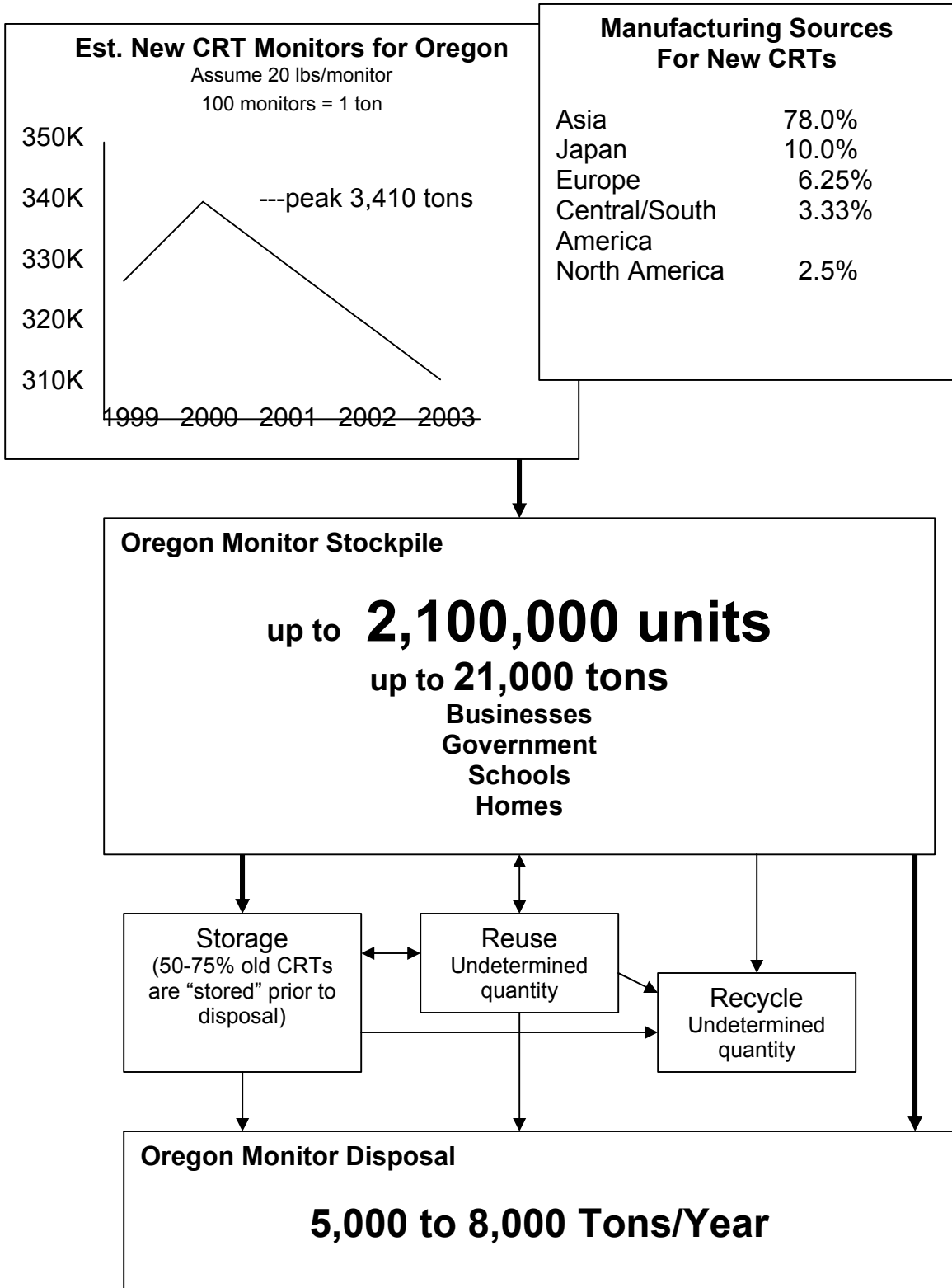
	1998	1999	2000	2001	2002	2003	2004	2005	2006	2007
PCs	5,187	6,006	7,980	10,563	13,965	15,960	15,330	15,981	15,078	15,456

This estimate of the weight of obsolete PCs is within the range for the weight of “computers” sorted during Oregon’s last reported waste composition study (1998). At that time, the computer category—including computers, CRT monitors, and peripherals—accounted for 0.25% of the state’s 2.7 million tons of solid waste, or 6,750 tons. However, on a statistical basis, the potential tonnage range of the computer category in 1998, at the 90% confidence level, could be as low as 3,510 tons to as much as 9,990 tons. This finding would tend to validate the estimates developed from the Baseline Report data. In that report, the estimated tonnage of computers and monitors for Oregon in 2001 was 10,563, and it was predicted to rise to nearly 16,000 tons annually in 2005.

According to researchers at Carnegie-Mellon University, computer monitors contribute nearly 50% of the mass and volume of computer systems. Thus, the tonnage of computer monitors being disposed in Oregon would be in the range of 5,000 to 8,000 tons per year.

Monitor Figure 1, on the following page, provides a simple diagram of the flow of computer monitor CRT products in the state, beginning with manufacturing, then through the wholesale and retail distribution chain to residents and businesses. The inflow of computers and monitors into the state is quite complex and involves hundreds of businesses in all parts of the world. The figure is thus necessarily simplified. The major end-of-life management methods are shown as well.

MONITOR FIGURE 1: Estimated Computer Monitor Flows in Oregon



End-of-life management

The website “thegreenpc.com” reports that there are only three end-use CRT recyclers in the US. None is located in Oregon. CRT recycling can be a nearly closed loop process. Some of the glass (leaded glass) can be ground to a powder and resold to CRT manufacturers or for flux in smelting operations and fill for paving materials.

There is significant overlap in the recovery of computers and monitors. As of this date, there are three companies in Oregon that handle electronic equipment for recycling, dismantling and donation. They are Quantum Resource Recovery in Beaverton, Computer Drive Connection in Cornelius, and Earth Protection Services in Lake Oswego. They handle computers and monitors and serve as collectors who then distribute the equipment to a variety of end markets. Financial arrangements for the collection and recycling of materials are considered proprietary. Similarly, the consultant team asked for end market information, but in most cases that was considered proprietary by the collectors.

Local or Regional Collectors

Quantum Resource Recovery receives electronic scrap from commercial and industrial sources as well as public drop-offs. Currently they collect about 15 to 20 tons of electronic scrap with about 95% of that coming from their industrial clients. The computer monitors are currently shipped to a facility in California that tests them for functionality and refurbishes them for reuse.

Computer Drive Connection handles computer/electronic materials and metals. They accept monitors, computer systems, disk drives, CD ROMs, VCRs, fax machines, telephones, keyboards, printers, power supplies, etc. This company adheres to the garbage hierarchy, stressing reuse over recycling. The collected computer equipment is refurbished and resold if possible, or recycled.

Earth Protection Services, Inc., accepts computer equipment for reuse and recycling. The company has an agreement with StRUT, a non-profit organization that refurbishes systems and donates them to schools. The equipment that is not functional is shipped to their Arizona facility for sorting, and then sent to Waste Management’s Asset Recovery Group in Phoenix. They donate 2 to 3 pallets of computers and monitors and a Gaylord of printers, copiers, keyboards and other peripherals to a non-profit approximately every two months. A factor to use to convert this to tons was not available.

Non-profit Organizations

There are several non-profit organizations that are set up to accept computer systems, including monitors. They manage the equipment for repair, donation and/or resale. Some of these organizations use their services as educational job training. Recycling of unusable electronic equipment is also available at each of these sites.

StRUT, Students Recycling Used Technologies, is an organization that has now spread statewide with 131 schools participating. This organization accepts electronic equipment donations for educational uses in schools. Working systems are donated for immediate use in classrooms. Non-working systems are used as instructional aids in hardware, software and system maintenance training. All equipment that is collected statewide is funneled into the warehouse and repair shop in Portland and is used within the K-12 classrooms. None is sold. Items that they cannot use are recycled.

As detailed in the CPU report, StRUT has worked with other organizations in the state to support weekend roundups of electronic equipment. StRUT tests all incoming components and got first rights of refusal on anything that worked. StRUT has a continuing agreement with Computer Drive Connections to get any equipment that they need for the schools.

StRUT estimates that they receive 25 to 40 pallets a day of computer equipment plus 10 to 15 individual donations. Any unneeded monitors they receive are shipped to an Asian market. StRUT recently began keeping records of number of units and amount of material handled. Historical information is not available. Costs for recycling services are not known.

Free Geek is a non-profit organization in Portland that accepts all computer technology regardless of condition for repair and reuse. Through this program, members can earn a free Linux operating system computer in exchange for donated time. Volunteers are used extensively for running the business and the training.

This organization has been actively accepting and repairing computer equipment and training volunteers since the Fall of 2000. Free Geek has not kept records on the number of systems refurbished and returned to use, but they estimate that it is in the hundreds. When the organization began, it was not ready to record weights and amounts of material handled, refurbished, and recycled, so no information exists.

All of their unusable material is recycled through Quantum Resource Recovery; the total to date is about 10.5 tons. They receive an occasional donation from outside the Metro region, but most equipment comes from businesses and individuals in the area. Most of their volunteers and members are local, also.

Oregon Public Networking of Eugene makes Internet-ready computers available to low income individuals and non-profits. They accept working, late model equipment,

including monitors for both Macintosh and PC systems. The equipment is repaired by volunteers and distributed to the recipient on a first come, first served basis.

During 2000, they refurbished approximately 150 systems (i.e., CPU, monitor, keyboard, with an average weight of 28.5 pounds each (2.14 tons). They recycled or disposed of an equal amount of material. This organization, working through the Eugene Free Community Network, employees local volunteers to refurbish systems that are kept in their community. Funding sources for the organization were not researched.

Industry profile

Manufacturing

Industry data for CRT production often includes information about all CRTs including those used for computer monitors, TVs and other display uses. Whenever possible, the consultant used data specific to each product. Most CRT manufacturing for computer monitors and TVs (less than 19 inches) takes place outside of the United States.

Data for 1997, show that Asia (excluding Japan) produced 79 percent of all CRTs. Taiwan has the highest concentration of CRT manufacturers, accounting for 33.6 percent of total world production in 1996. Japan supplies 10 – 15 percent of CRTs produced worldwide, primarily 17 inch and larger. Other major locations for CRT production include Korea and China.

According to a 1997 U.S. Census Bureau Report, most “electron tube manufacturing,” which includes CRTs, in the U.S. occurs in California, Florida, Massachusetts, New Jersey, New York, Ohio and Pennsylvania.

Table Monitor 4 shows CRT production figures per region for 1997 and projections for 1998 and 2000. In 1997, the United States accounted for only 1.9% of CRT production. Microelectronics and Computer Technology Corporation (MCC) projected that in the year 2,000 the U.S. would increase to 2.5% of the total market.

According to the U.S. Census Bureau approximately 3 million CRTs were manufactured in the U.S. in 1999. This is higher than 2000 projections shown in Table Monitor 4. Of the 3 million CRTs manufactured in the U.S., about 850,000 were exported. During the same year, 38 million CRTs were imported for consumption.

TABLE MONITOR 4: Color CRT (Monitor and TV) Production by Region (in thousand units)

Location	1997	1998*	2000*
Europe	4,800	5,300	6,000
North America	1,500	1,800	2,400
Asia	60,000	65,000	75,000
Japan	8,000	9,000	10,000
So-Central America	1,900	2,500	3,200
<i>Total</i>	<i>76,200</i>	<i>83,600</i>	<i>96,600</i>

Note: * are projected figures. CRT includes both computer CRTs and Television CRTs

Source: The Future of Liquid Crystal and Related Display Materials, Fuji Chimera Research, 1997 as shown in *Computer Display Industry and Technology Profile* by Microelectronics and Computer Technology Corporation (MCC) and EPA

Computer monitors are distributed through many routes. They may be sold under the manufacturer's name through retail stores, original equipment manufacturers (OEMs) or other system retailers, such as Compaq. The following manufacturers and retailers are major contributors to CRT production: Acer, Apple, Compaq, CTX, Dell, Digital, Eizo, Hitachi, Hewlett Packard, IBM, Iiyama, LG, MAG, Mitsubishi, NEC, Nokia, Panasonic, Samsung, Sharp, Siemens Nixxdorf, Sony, Toshiba and Viewsonic.

Table Monitor 5 shows United States market share per CRT brand name for 1997. These data may involve some TVs as well as computer monitors. Some companies are under-represented due to product end names (i.e. Sony monitors are manufactured for Dell, but called Dell monitors). Table Monitor 6 shows the 1996 industry market share for main color CRT monitor-tube manufacturers.

TABLE MONITOR 5: U.S. Market Share for CRTs by Top Brand Names

Company	Market Share
Compaq	10-12%
Dell	8-10%
Packard Bell	6-8%
Gateway 2000	6-8%
IBM	4-6%
Viewsonic	4-6%
NEC	4-6%
CTX	4-6%
Sony	2-4%
Acer	2-4%

Note: Includes both computer CRTs and TV CRTs. Unable to divide between the two.
 Source: Adapted from Stanford Resources, 1997 as shown in *Computer Display Industry and Technology Profile* by Microelectronics and Computer Technology Corporation (MCC) and EPA.

TABLE MONITOR 6: World Market Share (Color CRTs) by Manufacturer

Company	Market Share
Hitachi	20%
Sony	10-15%
Samsung	10-15%
Chunghwa	10%
Matsushita	5-10%
Toshiba	5-10%
Philips	5-10%
Lucky Goldstar	5-10%

Source: Adapted from Stanford Resources, 1997 as shown in *Computer Display Industry and Technology Profile* by Microelectronics and Computer Technology Corporation (MCC) and EPA.

The U.S. has only a handful of manufacturers of color monitor tubes and a few companies that produce CRT parts (i.e., Thomson, Technoglas and Corning manufacture CRT glass).

Based on NAICS information, the consultant created Table Monitor 7. The NAICS code that includes the manufacturing of CRTs is 334411, "Electron Tube Manufacturing." This category includes the following items: cathode ray tubes, klystron tubes, magnetron tubes and traveling wave tubes. The CRTs might be used for monitors or TVs. Note, this source shows there were two Oregon businesses that fit the electron tube category. They were quite small according to the number of employees. Additional data was not provided.

TABLE MONITOR 7: Electron Tube Manufacturing for 1997

NAICS code: 334411 / SIC code: 3671

	<i>U.S.</i>	<i>Oregon</i>
Industry Sales – All Products	\$3,825,058,000	ND
Employees	21,699	0-19
Payroll	\$730,071,000	ND
Establishments	158	2

Notes: ND = not disclosed to protect confidentiality of information on individual companies.

Source: U.S. Census Bureau Publications: *Manufacturing Industry Series* for U.S. and for Oregon and *County Business Patterns* for Oregon

The businesses that made up 80% of U.S. electron tube sales in 1998 are listed in Table Monitor 8. These businesses do not necessarily manufacture only CRTs since the SIC category of “Electron Tube Manufacturing” includes other types of electron tubes. None of these major manufacturers is located in Oregon.

TABLE MONITOR 8: Electron Tube Manufacturers in U.S. for 1998

NAICS code: 334411 / SIC code: 3671

<i>Company</i>	<i>City</i>	<i>State</i>	<i>Sales Volume (million \$)</i>	<i>Number of Employees</i>
Varian Associates Inc.	Palo Alto	CA	\$1,599	6,700
Zenith Electronics Corp.	Glenview	IL	\$1,288	15,900
Rauland Div	Melrose Park	IL	\$450	3,000
Philips Display Components	Ann Arbor	MI	\$270	1,800
Richardson Electronics Ltd.	Lafox	IL	\$255	700
Toshiba Display Devices Inc.	Horseheads	NY	\$220	1,500

Source for National Data: *Wholesale and Retail Trade USA*, Second Edition

The consultant was unable to obtain any information from Qwest in regards to Oregon listings under the SIC code 3671. Through the website “oregonlivehome.com” the consultant was able to locate two businesses that currently fall in the “Electron Tube Manufacturing” category. Since the Census Bureau information is three years old, there could be additional companies currently. Both of these companies manufacture cathode ray tubes as shown in Table Monitor 9. The consultant called both businesses and found that the RadiSys plant in Oregon produces CRTs and that the Tektronix Oregon plant uses CRTs made elsewhere in a variety of measuring and testing equipment.

According to oregonlive.com, RadiSys Corp. is listed as number 9 among the top Oregon businesses by revenue. RadiSys manufactures both CRTs and CPUs. The sales department at RadiSys indicated that their Hillsboro manufacturing plant distributes their products worldwide and employs approximately 1,000 people. In 1999, revenues for RadiSys totaled \$251 million with \$158 million of that making up U.S. sales.

Tektronix is listed as number 5 among the top businesses in Oregon according to oregonlivehome.com. Tektronix has two manufacturing plants in Oregon as well as their corporate headquarters. They distribute products internationally, with sales totaling over 1 billion last year. Over half of Tektronix sales were in the U.S.

TABLE MONITOR 9: Oregon CRT Manufacturers for 2001

<i>Company</i>	<i>City</i>	<i>Date Founded</i>	<i>Sales</i>	<i>Employees</i>	<i>Products</i>
RadiSys	Hillsboro	1987 by ex-Intel employees	\$251,090 million (year: 1999)	1,041	Computer products including CRTs and CPUs
Tektronix, Inc.	Beaverton	1946	\$1.05 billion (year: 2000)	4,457 (worldwide)	Test, measurement and monitoring equipment that use CRTs

Source: phone calls to RadiSys and Tektronix as well as www.radisys.com and www.tektronix.com

Computer Monitor Wholesalers

The wholesale classification category that includes monitors is “Computers and Computer Peripherals Equipment.” The description of businesses in this category according to NAICS is industry establishments that wholesale computers, computer peripherals, loaded computer boards, and/or computer software. Table Monitor 10 shows the number of U.S. and Oregon businesses that fall under this category according to the U.S. Census Bureau’s 1997 study.

TABLE MONITOR 10: Computer and Computer Peripheral Equipment and Software Wholesalers for 1997

NAICS code: 421430 / SIC code: 5045

	<i>U.S.</i>	<i>Oregon</i>
Industry Sales – All Products	\$221,477,412,000	\$935,594,000
Employees	317,662	2,202
Payroll	\$17,305,512,000	\$102,325,000
Establishments	16,929	210

Source: U.S. Census Bureau Publications- *Manufacturing Industry Series* for U.S. and for Oregon and *County Business Patterns* for Oregon

Top U.S. industries for Computer CRT sales for the NAICS category “Computer and Computer Peripheral Equipment and Software Wholesalers” are in Table Monitor 11. Qwest was able to list 88 businesses that are located in Oregon in this classification. A complete listing of these Oregon businesses is in Monitor Appendix 1.

TABLE MONITOR 11: Computer and Computer Peripheral Equipment and Software Wholesalers in 1997

NAICS code: 421430 / SIC code: 5045

<i>Company</i>	<i>City</i>	<i>State</i>	<i>Sales Volume (million \$)</i>	<i>Number of Employees</i>
Top U.S. Computer and Computer Peripheral and Software Equipment Wholesalers				
Avent Inc.	Great Neck	NY	5,390	9,400
Tech Data Corp.	Clearwater	FL	4,599	3,400
Mitsubishi Electronics America	Cypress	CA	4,400	3,000
Merisel Inc.	El Segundo	CA	4,049	2,300
InaCom Corp.	Omaha	NE	3,900	2,900
Intelligent Electronics Inc.	Exton	PA	3,588	2,600
Hitachi America Ltd.	Tarrytown	NY	3,500	6,000
Comdisco Inc.	Rosemont	IL	2,819	2,400
Hitachi Data Systems Corp.	Santa Clara	CA	2,000	2,300
CompuCom Systems Inc.	Dallas	TX	1,995	3,700
CHS Electronics Inc.	Miami	FL	1,855	2,300
Ingram Book Group, Inc.	La Vergne	TN	1,820	2,500
Pioneer-Standard Electronics	Cleveland	OH	1,509	2,100
AmeriData Technologies	Stamford	CT	1,500	3,500
Lanier Worldwide Inc.	Atlanta	GA	1,270	7,000
Wyle Electronics	Irvine	CA	1,245	1,500
Decision Data Inc.	Horham	PA	1,240	2,500
Marshall Industries	El Monte	CA	1,185	1,400
Handleman Co.	Troy	MI	1,181	3,500
Access Graphics Inc.	Boulder	CO	1,032	6,000
Ingram Micro Inc.	Santa Ana	CA	990	2,000
Satellite Information Systems	Boulder	CO	838	<100
Avnet Computer Inc.	Tempe	AZ	800	600
Computer and Computer Peripheral and Software Wholesalers in Oregon				
IBM Corp	Beaverton	OR	100-500	1,000-4,999
Sun Microsystems Inc.	Beaverton	OR	100-500	100-249
Timberline Software Corp.	Beaverton	OR	50-100	250-499
Christenson Electric Inc.	Portland	OR	50-100	100-249
Allen/Falk Inc.	Beaverton	OR	50-100	50-99
Epicor Software Corp.	Tualatin	OR	50-100	50-99
Microstandard Distributors	Beaverton	OR	20-50	50-99

Graybar Electric Co	Portland	OR	20-50	50-99
Avnet	Beaverton	OR	20-50	20-49
FEI America Inc.	Tualatin	OR	20-50	20-49
North Pacific Technology	Portland	OR	20-50	20-49
Sun Microsystems Inc.	Beaverton	OR	20-50	20-49
Supercom	Beaverton	OR	20-50	20-49
Convergence Communication	Portland	OR	20-50	20-49

Source for National Data: Wholesale and Retail Trade USA, Second Edition

Source for Oregon Data: Database from Qwest

Retailers

There are many methods of computer purchase for CRTs. CRTs can be purchased directly from some manufacturers, via Internet companies such as Dell, from wholesalers or from retail businesses that sell computer equipment exclusively or as part of a greater inventory.

The Qwest Dex website provided a list of more than 100 Oregon computer dealers, and it is included in Monitor Appendix 2. Finally, the Qwest website provided a separate list of used computer dealers, which has been included as Monitor Appendix 3. It was not possible to determine which of these new or used equipment dealers are the more significant.

Product Trends

During the past two decades computer monitor CRTs have been replaced in increasing numbers by liquid crystal display (LCD) and flat panel display (FPD) monitors. According to the Microelectronics and Computer Technology Corp. (MCC), there are a number of flat panel display technologies, but most (about 85%) are liquid crystal displays. Of all the uses for LCDs, computer displays make up between 55% - 65%.

The advent of digital high-definition television (HDTV) threatens to create a flood of discarded analog televisions in a short period of time. According to the Massachusetts CRT/Electronics Recycling Strategy, the impact could be enormous. "Waste volume will rise as the small business, institutional and residential sectors become less willing to repair or buy used electronics, and begin cleaning out the outmoded electronics from storage. As schools eventually discard their "donated" equipment and second-hand consumers are forced to buy "digital converter boxes" for used televisions, DEP expects several decades' worth of stored equipment—an estimated 500,000 tons—to enter the waste stream in a relatively compressed period of time (between five and 15 years)."

Sources

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- "Electrical & Electronic Equipment: Prospects for Household Appliances," The Warmer Bulletin, 2000
- "Old Computers now today's waste problem", by Trevor Maxwell, *Oregonian*, August 6, 2000
- "Our Legacy: Computer Junk", by John C. Dvorak, *PC Magazine*, February 6, 2001
- "High-tech trash causes waste worry", by Louise Knott Ahern, *The Detroit News*, September 13, 2000.
- "Rhode Island to Establish Nation's First Statewide Computer Recycling Program", by Brook Raflo, *Waste Age*, January 2001

Quantum Resource Recovery, 503-646-2427. Contact name: Kent Dunn

Computer Drive Connection, Inc., 503-992-0180. Contact name: Brad Franklin

Earth Protection Services, 503-620-2466.

Rhode Island Resource Recovery Corporation

Northeast Recycling Council, 802-254-3636

Waste Management Asset Recovery Group, 510-563-4214. Contact name: Kevin McCarthy

Lane County, 541-682-4339. Contact name: Tanya Baker

Bring Recycling, 541-746-3023. Contact name: Julie Daniel

Goldsmith Group, 317-710-0385. Contact name: Eric Goldsmith

StRUT, 503-251-3771. Contact name: Greg Sampson

BF-2 Metals, 541-683-2511. Contact name: Steve Root

Free Geek, 503-232-9350. Contact name: Phillip Santo

Northwest Microtechnics, 503-697-5010.

Oregon Public Networking, 541-484-9637. Contact name: John Crider

Share Technology—<http://sharetechnology.org/>
IBM Computer Recycling—www.ibm.com/ibm/environment/
Compaq Computer Recycling—www.compaq.com
Dell Computer Recycling—www.dell.com/us/en/hied/services/asset
Micron PC Recycling—www.micronpc.com/programs/mpower/ind_recycle.html
Electronic Industries Alliance—www.eia.org
Northeast Recycling Council—www.nerc.org/electpolicy
National Safety Council—www.nsc.org/ehc/epr2
NRC Electronics Recycling Initiative—www.nre-recycle.org/programs/electronics
EPA—www.epa.gov
Minnesota—www.moea.state.mn.us
King County—www.metrokc.gov/swd/CRP.htm
Florida—www.dep.state.fl.us
Northwest Product Stewardship Council—www.govlink.org/nwpsc
International Association of Electronics Recyclers—www.iaer.org
Institute of Electrical and Electronics Engineers, Inc.—www.ieee.org
Electronic Industries Alliance Environment Consumer Education—www.eiae.org
Oakland County, Michigan's recycling efforts—www.detnews.com/2000/technology/0009/13/a01-119191.htm

Computer repair shops, Portland

Carl's Computer Shop, 503-775-7055
MPH Computing/Cyber Exchange, 503-257-7308
Computer Doctor, 503-297-1011
AAA Rent-A Computer, 503-620-8944
Bargain City Sales and Rental, 503-761-8141

Computer repair shops, Beaverton

Datec INC., 503-641-6644
Aegis Tech, 503-641-0486

Computer repair shops, Tigard

All Phase Computer, 503-624-7447

Computer repair shops, Lake Oswego

Mac Shop Northwest, 503-443-4600

Computer repair shops, Eugene

Bit-by-Bit Computer Rentals, 541-485-2106
Jim Electronics, 541-343-7683
Mac Exchange, 541-461-6361
Northwest Computer Support, 541-484-2088
Abel Computing Inc., 541-343-3638

Computer repair shops, Ontario

McGowan Computers, 541-881-1467

Computer repair shops, La Grande

Beaver State Computer Services, 541-963-2630

Maverick Computers, 541-963-7712

Computer repair shops, Coos Bay

Bay Area Enterprises, 541-266-8936

Computer repair shops, Tillamook

Computer Savior, 503-842-3637

Computer repair shops, Medford

Bailey Computer Service Center, 541-772-7006

Cascade Computer Maintenance Inc., 541-770-2048

Certified Computer Specialists, LLC, 541-482-5903

Connecting Point Computer Center, 541-773-9861

Computer repair shops, Bend

Rent-A-Center, 541-385-7071

Computers by Ed, 541-382-3749

BA Computers, 541-388-8559

Computer Service Center, 541-382-7882

Dave's Electronics, 541-382-1536

Computer repair shops, Salem

AEO Computer Sales and Service, 503-304-4502

Capitol Computer Exchange, 503-391-7873

Television repair shops

PRO TV & Video Services, 503-643-8057

Sylvan Electronics, 503-292-1244

Martha Lake Electronics Inc, 503-648-2343

Palmer Electronics, 503-288-5356

Ace Electronics and Repairs, 503-772-9761

Monitor Appendix 1

Wholesalers: Computers and Computer Peripherals Equipment (includes Computer CRTs and CPUs)-5045

National:

SIC Code	Company Name	Address	City	Zip Code	Phone	Sales (million \$)	Number of Employees
5045	Avent Inc.	80 Cutter Mill Rd.	Great Neck	NY	516-466-7000	5,390	9,400
5045	Tech Data Corp.	5350 Tech Data Drive	Clearwater	FL	813-539-7429	4,599	3,400
5045	Mitsubishi Electronics America	PO Box 6007	Cypress	CA	714-220-2500	4,400	3,000
5045	Merisel Inc.	200 Continental	El Segundo	CA	310-615-3080	4,049	2,300
5045	InaCom Corp.	10810 Farnam Dr.	Omaha	NE	402-392-3900	3,900	2,900
5045	Intelligent Electronics Inc.	411 Eagleview Blvd.	Exton	PA	610-458-5500	3,588	2,600
5045	Hitachi America Ltd.	50 Prospect Ave.	Tarrytown	NY	914-332-5800	3,500	6,000
5045	Comdisco Inc.	6111 N. River Rd.	Rosemont	IL	847-698-3000	2,819	2,400
5045	Hitachi Data Systems Corp.	PO Box 54996	Santa Clara	Ca	408-970-1000	2,000	2,300
5045	CompuCom Systems Inc.	10100 N. Central	Dallas	TX	214-265-3600	1,995	3,700
5045	CHS Electronics Inc.	2153 NW 86th Ave.	Miami	FL	305-716-8273	1,855	2,300
5045	Ingram Book Group Inc.	1 Ingram Blvd	La Vergne	TN	615-793-5000	1,820	2,500
5045	Pioneer-Standard Electronics	4800 E. 131st Street	Cleveland	OH	216-587-3600	1,509	2,100
5045	AmeriData Technologies Inc.	700 Canal Street	Stamford	CT	203-357-1464	1,500	3,500
5045	Lanier Worldwide Inc.	2300 Pklake Dr. NE	Atlanta	GA	404-496-9500	1,270	7,000

5045	Wyle Electronics	15370 Barranca	Irvine	CA	714-753-9953	1,245	1,500
5045	Decision Data Inc.	400 Horsham Rd.	Horsham	PA	215-956-6700	1,240	2,500
5045	Marshall Industries	9320 Telstar Ave.	El Monte	CA	818-307-6000	1,185	1,400
5045	Handleman Co.	500 Kirts Blvd.	Troy	MI	248-362-4400	1,181	3,500
5045	Access Graphics Inc.	1426 Pearl St.	Boulder	CO	303-938-9333	1,032	6,000
5045	Ingram Micro Inc.	1600 E. Andrew Pl.	Santa Ana	CA	714-566-1000	990	2,000
5045	Satellite Information Systems	7464 Arapahoe Rd.	Boulder	CO	303-449-0442	838	<100
5045	Avnet Computer Inc.	3011 S 52nd St.	Tempe	AZ	602-414-6700	800	600

Oregon:

SIC Code	Company Name	Address	City	Zip Code	Phone	Sales (million \$)	Number of Employees
504503	IBM CORP	15450 SW KOLL PKWY	BEAVERTON	97006	503/626-5700	100 - 500	1,000 - 4,999
504503	SUN MICROSYSTEMS INC	8300 SW CREEKSIDE PL	BEAVERTON	97008	503/641-3151	100 - 500	100 - 249
504503	TIMBERLINE SOFTWARE CORP	15195 NW GREENBRIER PKWY	BEAVERTON	97006	503/690-6775	50 - 100	250 - 499
504506	CHRISTENSON ELECTRIC INC	6235 N BASIN AVE	PORTLAND	97217	503/285-1970	50 - 100	100 - 249
504506	ALLEN/FALK INC	9020 SW GEMINI DR	BEAVERTON	97008	503/646-0533	50 - 100	50 - 99
504509	EPICOR SOFTWARE CORP	8100 SW NYBERG RD	TUALATIN	97062	503/612-2600	50 - 100	50 - 99
504503	MICROSTANDARD DISTRIBUTORS	8082 SW NIMBUS AVE	BEAVERTON	97008	503/643-4886	20 - 50	50 - 99
504506	GRAYBAR ELECTRIC CO	901 NE 60TH AVE	PORTLAND	97213	503/249-1300	20 - 50	50 - 99
504503	AVNET	15580 SW JAY ST # 100	BEAVERTON	97006	503/439-6123	20 - 50	20 - 49
504503	FEI AMERICA INC	PO BOX 72	TUALATIN	97062	503/620-8640	20 - 50	20 - 49
504503	NORTH PACIFIC TECHNOLOGY	333 SE 2ND AVE	PORTLAND	97214	503/234-5000	20 - 50	20 - 49
504503	SUN MICROSYSTEMS INC	8705 SW NIMBUS AVE # 300	BEAVERTON	97008	503/627-0451	20 - 50	20 - 49

504503	SUPERCOM	10140 SW ALLEN BLVD # C	BEAVERTON	97005	503/526-8888	20 - 50	20 - 49
504506	CONVERGENCE COMMUNICATIONS	4386 SW MACADAM AVE	PORTLAND	97201	503/535-9200	20 - 50	20 - 49
504503	BOLIS TECHNOLOGY	995 TYINN ST	EUGENE	97402	541/683-3331	10 - 20	20 - 49
504503	COMPUTER TECHNOLOGY LINK CORP	9315 SW NIMBUS AVE	BEAVERTON	97008	503/646-3733	10 - 20	20 - 49
504506	URS DATA COMMUNICATIONS	123 NE 7TH AVE	PORTLAND	97232	503/236-2050	10 - 20	20 - 49
504503	ABLE COMPUTER SYSTEMS INC	7905 SW CIRRUS DR	BEAVERTON	97008	503/626-9953	10 - 20	10 - 19
504503	COMPUTER MEDICS NORTHWEST	223 NE RUSSELL ST	PORTLAND	97212	503/281-2524	10 - 20	10 - 19
504503	IET NW	16650 SW 72ND AVE	TIGARD	97224	503/603-9888	10 - 20	10 - 19
504503	NORTHWEST COMPUTER ACCESSORIES	2135 SE 6TH AVE	PORTLAND	97214	503/232-6324	10 - 20	10 - 19
504506	NETWORKS	5558 SE INTERNATIONAL WAY	MILWAUKIE	97222	503/786-9000	10 - 20	10 - 19
504506	STRUCTURED COMMUNICATION SYSTS	4382 SE INTERNATIONAL WAY # C	MILWAUKIE	97222	503/656-3530	10 - 20	10 - 19
504507	STORAGE TECHNOLOGY CORP	10260 SW GREENBURG RD # 400	PORTLAND	97223	503/293-3589	10 - 20	10 - 19
504503	CTL-COMPUTER TECHNOLOGY LINK	PO BOX 14848	PORTLAND	97293	503/230-0549	10 - 20	5 - 9
504506	MATRIX COMMUNICATIONS	4243 SE INTERNATIONAL WAY # C	PORTLAND	97222	503/654-3000	5 - 10	50 - 99
504507	POWER MAC PAC	12310 NE WHITAKER WAY	PORTLAND	97230	503/256-5210	5 - 10	20 - 49
504503	NORTHWEST MICRO INC	6250 SW ARCTIC DR	BEAVERTON	97005	503/626-2555	5 - 10	10 - 19
504506	BEJED INC	4824 NE 42ND AVE	PORTLAND	97218	503/281-8153	5 - 10	10 - 19
504506	PROCOM COMMUNICATIONS INC	PO BOX 22288	PORTLAND	97269	503/233-8037	5 - 10	10 - 19
504503	ASI CORP	7291 SW TECH CENTER	TIGARD	97223	503/443-4800	5 - 10	5 - 9

		DR					
504503	DIGI INTERNATIONAL	14780 SW OSPREY DR	BEAVERTON	97007	503/521-8730	5 - 10	5 - 9
504503	EMC CORP	10260 SW GREENBURG RD	PORTLAND	97223	503/293-8450	5 - 10	5 - 9
504503	INTERNET TECHNOLOGY INC	10200 SW ALLEN BLVD # E	BEAVERTON	97005	503/644-4156	5 - 10	5 - 9
504503	MAX COMPUTER STATION	18210 SE BURNSIDE ST # G	PORTLAND	97233	503/665-7189	5 - 10	5 - 9
504503	MERIT DISTRIBUTING	7244 SW DURHAM RD	TIGARD	97224	503/639-4229	5 - 10	5 - 9
504503	PENSTOCK ECR	8313 SW CIRRUS DR	BEAVERTON	97008	503/644-0800	5 - 10	5 - 9
504503	RAL MEDIA PRODUCTIONS	809 SW CANYON DR	REDMOND	97756	541/923-4616	5 - 10	5 - 9
504503	SPEAKS & ASSOC	943 AUTOMATION WAY # F	MEDFORD	97504	541/734-9494	5 - 10	5 - 9
504503	VO2MAX	899 SE GLENWOOD DR # E1	BEND	97702	541/318-1044	5 - 10	5 - 9
504506	CASCADE TELECOMMUNICATION	345 NE CLAY AVE	BEND	97701	541/388-5158	5 - 10	5 - 9
504506	DOW JONES NEW SVC	6400 SW CANYON CT	PORTLAND	97221	503/292-0513	5 - 10	5 - 9
504506	NETWORK SERVICES	317 SW ALDER ST	PORTLAND	97204	503/224-2022	5 - 10	5 - 9
504506	STAR ELECTRONICS	827 NE A ST	GRANTS PASS	97526	541/474-0548	5 - 10	5 - 9
504503	CORVALLIS MICROTECHNOLOGY	413 SW JEFFERSON AVE	CORVALLIS	97333	541/752-5456	2.5 - 5	20 - 49
504503	POLARIS COMMUNICATIONS INC	10200 SW ALLEN BLVD # A	BEAVERTON	97005	503/643-1533	2.5 - 5	20 - 49
504506	WELBURN ELECTRIC INC	PO BOX 329	PHOENIX	97535	541/535-3727	2.5 - 5	20 - 49
504503	VALLEY EQUIPMENT CO	PO BOX 12849	SALEM	97309	503/364-4491	2.5 - 5	10 - 19
504503	AMAZING ENTERPRISES	6327 SW CAPITOL HWY # 129	PORTLAND	97201	503/636-1199	2.5 - 5	5 - 9
504503	CIRRUS LOGIC INC	6650 SW REDWOOD LN	TIGARD	97224	503/620-5547	2.5 - 5	5 - 9
504503	JPI CO	10110 SW NIMBUS AVE # B10	PORTLAND	97223	503/598-0500	2.5 - 5	5 - 9
504503	N STORE TECHNOLOGIES	8625 SW CASCADE AVE	BEAVERTON	97008	503/526-9191	2.5 - 5	5 - 9

		# 270					
504503	PICOJET INC	3155 SW 234TH AVE	HILLSBORO	97123	503/356-9196	2.5 - 5	5 - 9
504503	PRACTICAL COMPUTERS INC	1200 MOHAWK BLVD # D	SPRINGFIELD	97477	541/726-7789	2.5 - 5	5 - 9
504503	R SQUARED	2092 NW ALOCLEK DR # 513	HILLSBORO	97124	503/533-0517	2.5 - 5	5 - 9
504506	ICM-COMMUNICATIONS	12300 SE MALLARD WAY # 250	PORTLAND	97222	503/353-3086	2.5 - 5	5 - 9
504503	HORIZON MICRO DISTRIBUTORS	803 SW CIRBUS DR	BEAVERTON	97008	503/469-0147	2.5 - 5	1 - 4
504503	IMPERIAL DIRECT	55 NW 3RD ST	GRESHAM	97030	503/618-9162	2.5 - 5	1 - 4
504503	TRINITY TECHNOLOGIES INC	6443 BEAVERTON HILLSDALE # 320	PORTLAND	97221	503/291-1333	2.5 - 5	1 - 4
504506	CMS ENTERPRISES INC	17233 SE DIVISION ST	PORTLAND	97236	503/761-3910	2.5 - 5	1 - 4
504506	QUALITY MOBILE COMMUNICATIONS	4018 NE 112TH AVE # D6	PORTLAND	97220	503/240-8525	2.5 - 5	1 - 4
504507	RADIO SHACK	1023 MAIN ST	SWEET HOME	97386	541/367-4231	2.5 - 5	1 - 4
504507	RADIO SHACK	250 NE 3RD ST	PRINEVILLE	97754	541/447-5128	2.5 - 5	1 - 4
504503	NORTHWEST COMPUTER SUPPORT	4660 PORTLAND RD NE # 101	SALEM	97305	503/463-4555	1 - 2.5	5 - 9
504506	DAVIDSON & ASSOC INC	800 WILLAMETTE ST # B50	EUGENE	97401	541/343-0508	1 - 2.5	5 - 9
504506	DURACOM INC	4130 SW 117TH AVE	BEAVERTON	97005	503/646-8418	1 - 2.5	5 - 9
504507	BITS & PC'S COMPUTERS	4555 LIBERTY RD S # 180	SALEM	97302	503/364-2487	1 - 2.5	5 - 9
504507	COMPUTER SOLUTIONS	2609 SE 122ND AVE	PORTLAND	97236	503/761-6300	1 - 2.5	5 - 9
504503	AB MOORE ENTERPRISES INC	7923 N SEWARD AVE	PORTLAND	97217	503/285-5848	1 - 2.5	1 - 4
504503	AMT INC	10260 SW NIMBUS AVE # M7A	TIGARD	97223	503/620-8979	1 - 2.5	1 - 4
504503	C D ROM WAREHOUSE	7901 SW NIMBUS AVE	BEAVERTON	97008	503/526-8626	1 - 2.5	1 - 4
504503	COMPU TECH SYSTEMS INC	1246 S RIVERSIDE AVE	MEDFORD	97501	541/734-4380	1 - 2.5	1 - 4
504503	GSA	4660 MAIN ST # 120	SPRINGFIELD	97478	541/736-9256	1 - 2.5	1 - 4

504503	GSA	1470 NE 1ST ST # 900	BEND	97701	541/317-0756	1 - 2.5	1 - 4
504503	INTERNATIONAL BUSINESS CO	10700 SW BEAVERTON HILLSDALE	BEAVERTON	97005	503/671-9104	1 - 2.5	1 - 4
504503	NOVELL INC	10220 SW GREENBURG RD # 100	PORTLAND	97223	503/293-8346	1 - 2.5	1 - 4
504506	TELCOM DESIGN & SVC	4440 SW CORBETT AVE	PORTLAND	97201	503/226-7577	1 - 2.5	1 - 4
504507	GROVER CONSULTING SVC	PO BOX 766	BAKER CITY	97814	541/523-4567	1 - 2.5	1 - 4
504506	WIRELESS PROFESSIONAL COMM	21785 SW TUALATIN VALLEY # P	BEAVERTON	97006	503/848-0160	.5 - 1	5 - 9
504507	TELXON CORP	4500 KRUSE WAY	LAKE OSWEGO	97035	503/699-7350	.5 - 1	5 - 9
504503	C & L TERMINALS INC	PO BOX 14944	PORTLAND	97293	503/231-0333	.5 - 1	1 - 4
504503	GENESIS COMPUTER SYSTEMS	6173 WELDON PL SW	ALBANY	97321	541/917-1808	.5 - 1	1 - 4
504503	LAW CYPRESS DISTRIBUTING	4370 NE HALSEY ST # 118	PORTLAND	97213	503/249-2101	.5 - 1	1 - 4
504506	SJI CORP	1600 SW 4TH AVE # 870	PORTLAND	97201	503/221-1525	.5 - 1	1 - 4
504507	CYBER SHOPPE	130 E 2ND ST	PRINEVILLE	97754	541/416-8944	.5 - 1	1 - 4
504507	T S COMPUTERS	1924 BROADWAY ST # D	BAKER CITY	97814	541/523-7889	.5 - 1	1 - 4
504503	FORE SYSTEMS INC	10260 SW GREENBURG RD # 400	PORTLAND	97223	503/243-4626	< .5	1 - 4
504507	ENU INC	4912 NE 122ND AVE	PORTLAND	97230	503/261-1122	< .5	1 - 4

Monitor Appendix 2

Computer Dealers in Oregon

Company	Address	City	Phone
Atwin Computer Service Inc	1389 Lancaster Dr NE	Salem	503-399-7967
101 Computer Center	3601 Highway 101 N.	Gearhart	503-717-1601
A Prompt Computer	701 E 3rd St.	McMinnville	503-434-1174
A+ Computers	210 Liberty St. SE		503-375-3139
Aaron Embree & Associates	PO Box 944	Silverton	503-873-6377
ABACUS Computers Inc	498 Church St. NE	Salem	503-362-8921
ABEL Computing Inc.	410 W 13th	Eugene	541-343-3638
Absolute Systems	140 NE 1st Ave.	Mill City	503-897-3901
Abtech Computers	17300 SW Upper Boones Ferry Rd.	Portland	503-670-7900
Access Computer	4918 River Rd. N	Salem	503-304-9490
Action Business Systems	151 E Olive	Newport	541-265-8226
Adept Computer Services Inc.	1325 W 7th	Eugene	541-343-9393
Advanced Business Systems	4509 S 6th St	Klamath Falls	541-884-6492
Advanced Computer Systems	42645 Rhody Ln	Port Orford	541-332-1503
Advanced Digital Technology		Coos Bay	541-269-1010
Advanced Digital Transport Systems	5575 SE Alexander St. Suite 300	Hillsboro	503-848-6400
Advanced Mobile Communications	1055 Hwy 395 S, Ste 313	Hermiston	541-567-7655
Advanced P C			541-923-6055
Adya Computer Systems	10260 SW Nimbus Ave.	Tigard	888-464-2392
AEC Inc.	20752 E Cannon Rd	Brightwood	503-622-3158
After Hours Computers	608 1/2 N Main Street	Milton-Freewater	541-938-6883
Alchemy Marketing Inc	1315 Adams Ave	La Grande	541-962-0315
Allen's 101 Computers	180 Michigan Ave. SE	Bandon	541-347-7507
Alman Macintosh Services			541-736-0500
Alpha 2 Omega Computers	2826 Three Mile Road	The Dalles	541-298-7222
Amdahl Corporation	10260 SW Greenburg Rd, Suite 400	Portland	503-293-8446
American Microtech	26015 Ballston Rd	Sheridan	503-843-4884
Ampersand	3535 Commercial SE		503-362-7075

Applied Information Services	12950 SW Pacific Hy	Tigard	503-639-0777
Aprovision	5319 SW Westgate Dr., Ste 168	Portland	503-292-6336
Archival Associates	1890 SW 3rd St	Corvallis	541-754-9422
Arrowhead Industries	11 SE 3rd Ave	Ontario	541-889-1169
Autumn Computer Systems	800 NW Starker Ave. Suite 17	Corvallis	541-753-8813
Avalon Technology Group	0607 SW Idaho St	Portland	503-246-3630
BA Computers	642 NE 1st	Bend	541-388-8559
Basin Multimedia Magic	3146 S 6th St	Klamath Falls	541-884-9552
Beaver State Computer Services	1305 Adams Ave.	La Grande	541-963-2630
BECCO Inc.	607 Railroad	Brookings	541-469-2113
Bellevue Computer Inc.	1865 NW 9th St.	Corvallis	541-757-3487
Best Buy	11703 NE Glen Widing Dr.	Portland	503-253-1177
Best Little Computer Store	Hwy. 11	Milton-Freewater	541-938-7569
Best Little Computer Store		Milton-Freewater	800-850-7569
Bit's & PC's Computers	4555 Liberty Rd.		503-364-2487
BKS Computers	1745 Lancaster Drive NE		503-375-3107
Blue Mountain Computer	115 E. Main St.	Enterprise	541-426-4784
Bohdan Associates	9130 SW Pioneer Ct	Willsonville	503-682-7670
Brad's Computer Connection	340 S Fleishauer Ln	McMinnville	503-434-6136
Brandon Computer	RR 1 Box 904	Brandon	541-347-3209
Brightstone Macintosh Consulting & Sales	2325 NE Davis	Portland	503-235-1964
BroTek Computer Solutions	373 NE Greenwood Ave.	Bend	541-382-9499
Business Systems From Sasse	900 SE Wilson Ave.	Bend	541-389-7799
Byte Size Solutions, Inc	815 NW 9th St.	Corvallis	541-752-6649
C.S.I. Computer Division	419 SE Main St.	Roseburg	541-672-6631
Capitol Computer Exchange	1095 Liberty St. NE		503-391-7873
Cascade Chips	61445 South Highway 97	Bend	541-382-6650
Castle Computers	3570 W 11th	Eugene	541-465-8888
C-Delta Industries	1133 S Riverside Ave.		541-245-2539
Century Computers	205 SE 181st Ave	Portland	503-669-3462
Cityview TV & Computer Inc.	2352 W 11th	Eugene	541-683-3518
Cityview TV & Computer Inc.	933 NW Circle Blvd	Corvallis	541-738-2524
Clackamas Computers	15791 SE 90th Ave.	Clackamas	503-650-0379
Clark's Computer Service	215 E. Powell Blvd.	Gresham	503-492-7153
CMI Business Systems	1020 Knutson Ave.	Medford	541-772-9174

CNS	Wickiup Junction La	Pine	541-536-1603
ColorXCorp	9900 SW Hall Blvd.	Portland	503-892-9859
Colt Computer Systems			503-540-0823
Compaq Computer Corp			800-345-1518
Compatability Plus	1410 Main St.	Springfield	541-726-2409
Compu Com Systems Inc.	5 Centerpointe Dr. #550	Lake Oswego	503-684-4919
CompuCare	2544 Shasta Way	Klamath Falls	541-882-3285
CompUSA	1780 N. Jantzen Beach Ctr	Portland	503-240-4900
CompUSA	10355 SW Cascade	Tigard	503-684-1662
CompuSense	2065 NW 34th St.	Lincoln City	541-996-3313
Comp-U-Talk Inc	2561 Broadway St	North Bend	541-756-8770
CompuTech Systems Inc.	206 S. Central	Medford	541-734-4380
Computek	1615 SW Jefferson	Portland	503-274-4384
Computek West	14246 SW 133rd Ave	Tigard	503-684-3044
Computer & Software Factory Outlet	5835 NE 122d	Portland	503-257-8151
Computer & Software Factory Store	5835 NE 122nd	Portland	360-737-0927
Computer 7	498 Columbia Ave.	Nyssa	541-372-3361
Computer 7	498 Columbia Ave.	Nyssa	541-372-3361
Computer Base	2003 NW	Monroe	541-737-2259
Computer Broker	400 Virginia Ave. #101	North Bend	541-756-0240
Computer Concepts	25102 SW Ladd Hill Rd	Sherwood	503-625-5501
Computer Connection	PO Box 7136	Salem	503-304-4554
Computer CRT Inc.	8366 SW Nimbus	Beaverton	503-626-6939
Computer Drive Connection	537 N 10th Ave.	Cornelius	503-992-0177
Computer Exchange The	311 SW Jefferson Ave.	Corvallis	541-752-1839
Computer Guy The	1612 SW Emigrant Ave.	Pendleton	541-276-5463
Computer Medics NW LLC	223 NE Russell	Portland	503-281-2524
Computer Merchant The	1625 SE Woodward	Portland	503-731-6090
Computer Peddler	4029 State St. NE		503-375-7737
Computer Power	740 Avenue H	Seaside	503-738-9648
Computer Renaissance	2265 Lancaster Dr. NE	Salem	503-585-0936
Computer Renaissance	1011 Valley River Way		541-338-4445
Computer Restore	1031 SE Mill St.	Portland	503-233-7879
Computer Savior	2006 First St.		503-842-3637
Computer Shack			541-476-5484
Computer Solution NW	2609 SE 122d	Portland	503-761-6300
Computer Store The	61 W 8th	Eugene	541-343-1434

Computer Store The	10115 SW Nimbus	Tigard	541-754-0811
Computer Store The	700 NE Multnomah	Portland	503-238-1200
Computer Systems West Inc.	78 Centennial Loop, Suite E.	Eugene	541-342-4153
Computer World	2107 Highway 101 N	Florence	541-997-9616
Computer-Lab	2476 Williams Hwy	Grants Pass	541-479-0806
Computerland	1936 12th St.	Hood River	541-386-9311
Connecting Point Computer Centers	514 NW Franklin	Bend	541-385-6757
Connecting Point Computer Centers	545 Stevens St.	Medford	541-773-9861
Daisy Business Systems	28 S Peach St	Medford	541-773-2142
Data Tek	100 Depot St.	Rogue	541-582-0085
Davis Computer Services Inc.	2101 Main St. #18		541-523-0270
Delta Computer	1440 SE Powell Bv	Portland	503-232-5292
Demar Associates	5600 SW Artic Dr. #110	Beaverton	503-848-8084
Design Systems	1180 S Main St	Lebanon	541-451-5611
Digital Magic	137 First Street	Myrtle Creek	541-863-3886
DSI Computers	145 NE Revere Ave.	Bend	541-382-1536
Egghead.com	www.egghead.com		
FEI America Inc.	6265 SW Lakeview Blvd.	Lake Oswego	503-620-8640
Infogroup Northwest	2225 Coburg Rd		541-485-0155
Infosys Technologies	248 Hayes Ave.	Cottage Grove	541-942-3899
Interactive Computing		Ashland	541-482-1448
MacGraphics	208 NW 6th St.		541-476-1711
Maverick Computers	222 Fir St.	La Grande	541-963-7712
McLoughlin Computer Center	3637 NE Sandy Blvd	Portland	503-231-0454
MicroAge Computer Centers	875 Wilson St.		541-343-9210
MicroAge Computer Centers	900 Main St.	Klamath Falls	541-882-9603
MPH Computing-Cyber Exchange	11904 NE Halsey St.	Portland	503-257-7308
Northwest Micro Inc.	6250 SW Artic Dr.	Beaverton	503-626-2555
Office Equipment Company	2300 Oakmont Way Ste 100		541-342-3325
Pacific Information Systems	10230 SW Hall Blvd.	Portland	503-244-2100
Power Mac Pac	12310 NE Whitaker Way	Portland	503-256-5210
PowerMax - The Mac Experts			800-844-3599
Precision Computers Inc .	1111 SE Stephens	Portland	503-234-4553
Sears Roebuck & Co	Bend River Mall	Bend	541-388-5746
Sears Roebuck & Co	827 Lancaster Dr. NE		503-363-9191
TJ's Computers LLC	P.O. Box 5667	Beaverton	503-356-1908
TTJ Computer Services Inc.	1836 Lancaster Dr. NE	Salem	503-363-2693
User Friendly Computer Services		Portland	503-259-2888
Valley Software Co	1328 NW 6th St.	Grants Pass	888-541-4710

Monitor Appendix 3

Used Computer Dealers in Oregon

Company	Address	City	Phone
AAA Cash Now	2929 SE Powell Blvd.	Portland	503-231-4775
Ace Buyers	3144 W 11th	Eugene	541-344-8871
Ace Buyers	823 Highway 99N	Eugene	541-688-8888
Ace Buyers	3697 Franklin Bv.	Eugene	541-726-1735
Ace Buyers	2530 Pacific Blvd SE	Albany	541-926-7199
Associated Buyers	443 NE Stephens		541-673-0123
Capitol Computer Exchange	1095 Liberty St NE		503-391-7873
Cash House	1250 Ferry St. SW	Albany	541-928-6668
Computer Drive Connection	537 N 10th Ave.	Cornelius	503-992-0177
Computer Renaissance	2265 Lancaster Drive NE	Salem	503-585-0936
Computer Renaissance	1011 Valley River Way		541-338-4445
Computer Restore	1031 SE Mill St	Portland	503-233-7879
Computer Warehouse	2126 Main St.	Springfield	541-736-3997
Custom Business Systems	1950 Winchester Ave.	Reedsport	541-271-3681
Demar Associates	5600 SW Artic Dr #110	Beaverton	503-646-9931
Exchange HQ.Com	326 SE Morrison	Portland	503-231-2739
FlashBack Computers	1713 Camino Dr.	Forest Grove	503-359-4418
J&M Computers Co	PO Box 5893	Charleston	541-888-6552
Maverick Enterprises	220 Fir St.	La Grande	541-963-7712
Pacific Computers & Info. Systems	12725 SW 66th Ave.	Portland	503-684-5066
Ready Access Memory Inc-RAM	1160 N Park Ave.	Eugene	541-461-2046
Stuff	9800 SE 82d Ave.	Portland	503-775-2056
Techmedic Computers	2125 W 7th	Eugene	541-484-3603
Technology Suppy Service Inc.	936 SE 34th	Portland	503-236-2641
Wholesale Computers	952 Chickadee Ct. NE	Salem	503-391-5753