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ECONOMIC ANALYSIS OF CATHODE RAY TUBE MANAGEMENT, NOTICE OF PROPOSED RULEMAKING

U.S. Environmental Protection Agency
Office of Solid Waste

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1.0 Introduction

Computers and televisions are in almost every household and business in the United States. Several hundred million computers and televisions are in use and many more millions are believed to be in storage. Both computer monitors and televisions typically contain a cathode ray tube (CRT), which creates the images seen on the television or computer monitor. The glass in CRTs from color computer monitors and color televisions can contain enough lead to qualify these devices as hazardous waste (D008, characteristically hazardous for lead) when they are discarded. Under current Resource Conservation and Recovery Act (RCRA) regulation, post-consumer CRTs from many commercial and industrial generators are hazardous waste whether disposed, or sent for reclamation, such as disassembly and glass recycling (40 CFR §261.2(C)(3)). CRTs that are sent for refurbishment or reuse are not considered a solid waste under RCRA.

Businesses that discard (i.e., "generate") post-consumer CRTs must comply with RCRA regulations and dispose of computer monitors and televisions by treating them for lead and sending them to a Subtitle C or D landfill or sending them to recyclers or smelters. Households are excluded from RCRA Subtitle C hazardous waste regulation and many smaller businesses do not generate enough CRTs to trigger RCRA generator requirements; these entities tend either to store old electronic equipment or to send it to Subtitle D landfills. Most of the current disposal methods (Subtitle C and D landfilling and lead smelting) do not take advantage of the full intrinsic value contained in CRT glass or in other CRT components that can be recycled back into high value products, such as new CRT glass or recovered gold and copper. While there is already a demand for the CRT glass contained in computer monitors and televisions, RCRA regulations that can apply for applicable hazardous waste generators can be burdensome and may discourage this type of recycling. The requirements under the current RCRA regulations include: storage limits, manifesting, recordkeeping, safety training, and biennial reporting by large generators. The administrative, transportation, treatment, disposal, and storage costs associated with the current regulations add to the cost of recycling old CRT glass back into new CRT glass, and also tend to discourage glass-to-glass recycling.

To remedy this situation the Common Sense Initiative (CSI) Council tasked the Computers and Electronics Sector Subcommittee with recommending regulations that encourage environmentally sound recovery of CRTs and that eliminate unnecessary regulatory burden for recycling post-consumer CRTs back into new CRT glass. In June 1998, the CSI Computers and Electronics Sector Subcommittee recommended changes to the current regulations specifically for CRTs that encourage recycling CRT glass back into new CRT glass. The recommendations included extended storage limits, no manifesting, reduced recordkeeping requirements, and no biennial reporting. EPA's proposed regulation builds on the CSI recommendation by further streamlining the requirements and by also reducing the regulatory requirements for CRTs sent to lead smelters. EPA believes that the additional capacity at lead smelters may be necessary to recycle all of the CRTs generated and, therefore, to achieve the greatest reduction in CRTs requiring disposal. The proposed regulation is expected to encourage glass-to-glass and other types of recycling, reduce the costs on the regulated community, and maintain or increase the degree of protection provided to human health and the environment.

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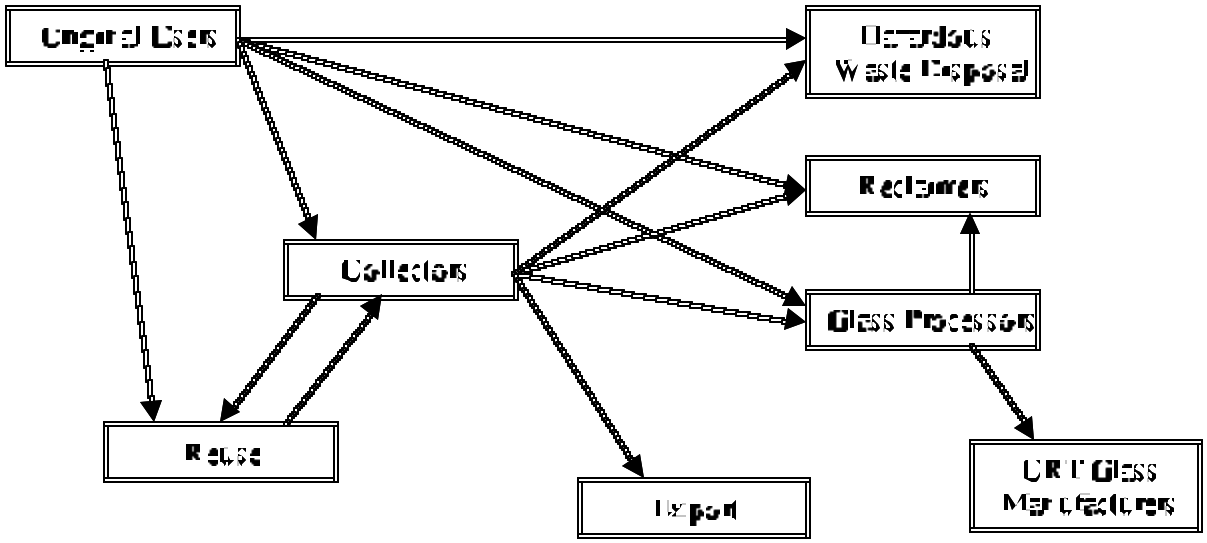
The purpose of this analysis is to analyze the costs and economic impacts of EPA's proposed rule (primary alternative) and the CSI alternative related to encouraging environmentally sound recycling of CRTs. To achieve this purpose the analysis estimates the incremental cost of the alternatives over current regulations (the "baseline"). The analysis uses two different baselines: one that models full compliance with RCRA Subtitle C requirements (referred to as the Subtitle C management baseline), and one that reflects what is possibly current CRT disposal practice (referred to as the Subtitle D management baseline). The remainder of this report is organized as follows: Section 2 provides an overview of the types of entities involved in generating and recycling CRTs. Section 3 describes the methodology used to estimate the costs of the proposed rule and to calculate the first order economic impacts associated with the costs. Sections 4 and 5 present, respectively, the results of the cost analysis for each of the two baselines. Section 6 presents impact analysis results. Section 7 discusses environmental benefits associated with the proposed regulatory changes. Other administrative requirements are addressed in Section 8. Finally, Section 9 concludes with a summary of the analytical results.

2.0 Overview of the Entities Involved in Generating and Recycling CRTs

This section describes the entities involved in generating, collecting, transporting, reclaiming, and recycling CRTs from televisions and computer monitors. CRTs from televisions and computer monitors are treated the same when discarded, so the same entities typically handle both types of CRTs. However, this analysis models the management of CRTs only from color computer monitors because these CRTs comprise the vast majority of CRTs discarded by regulated entities. CRTs from televisions only are included in a sensitivity analysis that includes televisions from unregulated entities (see Sections 4.2.4 and 4.3.4).

The seven economic based entities involved in generating and managing CRTs are: original users, reusers, collectors (including exporters), hazardous waste disposal facilities, reclaimers, glass processors, and CRT glass manufacturers. Exhibit 2-1 is a simplified diagram of how CRTs flow between these entities. In this analysis, *original users* are businesses that first use monitors and televisions for their intended purpose. They may be regulated generators or they may be unregulated under RCRA, as discussed in Section 2.1. Establishments that reuse computers are similar to original users, but are typically not regulated (see Section 2.2). In this analysis, *collectors* are intermediaries that accept discarded CRTs from original users or reusers prior to sending the CRTs or CRT glass to other entities. Like original users, collectors may be regulated generators or they may be unregulated. Collectors are described in more detail in Section 2.3. *Reclaimers* considered in this study consist of lead smelters, and are described in more detail in Section 2.4. *Glass processors* prepare CRT glass for introduction into a CRT glass manufacturer's glass furnace, and are the subject of Section 2.5. Hazardous waste facilities and CRT glass manufacturers are included in Exhibit 2-1 for completeness but, because these types of entities are not affected by the proposed alternatives, they are not discussed further in this overview. Section 2.6 briefly discusses the transporters of CRTs that move CRTs from one entity to the next. Finally, under the CSI alternative a category of entities is defined, *CSI handlers*, that can be either original users or certain collectors. CSI handlers are described in more detail in Section 2.7.

Exhibit 2-1: CRT Life-Cycle Flow Diagram



2.1 Original Users

Original users are establishments that first use and discard CRTs. Original users include entities that use computers and televisions in the normal course of their business operations and that periodically discard them. For example, original users range from large multinational corporations down to small local real estate offices. Original users send CRTs for reuse, recycling, reclamation, disposal, or to collectors. As considered in this analysis, original users do not include entities that are explicitly excluded from hazardous waste requirements (e.g., households).

Current RCRA Regulatory Requirements

Because color CRTs contain leaded glass that typically qualifies as hazardous waste when disposed, any entity that uses computers or televisions may be a regulated generator. However, under current EPA policy, used CRTs with the potential for reuse are assumed to be products and not wastes if there is the possibility that the CRTs will be refurbished or reused. Therefore, original users that discard intact CRTs are only regulated generators if they send the CRTs for intended disposal (e.g., a landfill), to a lead smelter, or to a glass processor that does not refurbish any of the CRTs it receives. Original users that discard broken CRT glass are regulated generators regardless of where they are sent. This analysis assumes that original users only discard intact CRTs.

Original users are regulated if they produce hazardous wastes in quantities above a threshold of 100 kilograms (kg) per month. Original users that produce less than 100 kg per month of hazardous waste are conditionally exempt from RCRA requirements and are not included in this analysis (40 CFR §261.5). Original users that produce between 100 and 1,000 kg per month of hazardous waste are

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small quantity generators (SQGs) and must comply with storage limits, manifesting, recordkeeping, and safety training requirements (40 CFR Part 262 generally). Original users that generate more than 1,000 kg per month of hazardous waste are large quantity generators (LQGs) and must comply with the same or more stringent requirements as SQGs and must also comply with biennial reporting requirements. Due to the 100 kg per month threshold (equivalent to approximately seven CRTs), only relatively large original users are likely to qualify as regulated generators based solely on their generation of post-consumer CRTs. However, facilities that generate hazardous waste other than CRTs may qualify as a regulated generator with less than 100 kg per month of CRTs. The treatment of these generators in this analysis is discussed in Section 3.3.4.

Primary and CSI Alternatives

Under the primary alternative, CRTs that are sent to reclaimers and glass processors (see Sections 2.4 and 2.5) are excluded from the definition of solid waste. Thus the original users that send CRTs to these CRT management options will no longer be considered generators of CRTs. Original users that send their CRTs for disposal continue to be regulated generators under the primary alternative.

Under the CSI alternative, CRTs that are sent to glass processors (see Section 2.5) are excluded from the definition of hazardous waste. Therefore, the original users that send CRTs to glass processors are no longer considered generators of CRTs. Original users that send their CRTs for disposal or to reclaimers continue to be generators under the CSI alternative. Thus the CSI alternative also reduces the number of original users subject to the rule, but not by as many as does the primary alternative.

2.2 Establishments that Reuse Monitors

Establishments that reuse CRTs include schools, foundations, and other not-for-profit entities. Although reusers of CRTs can face the same regulatory conditions as original users of CRTs (i.e., because RCRA regulations do not define/distinguish between them), the analysis assumes that establishments that reuse monitors do not discard enough CRTs to trigger the RCRA requirements or they are exempted entities. This category of establishments is included in the analysis for completeness of the CRT life cycle flow.

2.3 Collectors

The analysis recognizes a category of entities called CRT "collectors," which includes intermediary entities that collect intact televisions or computer monitors, and then send the CRTs or CRT glass for reuse, recycling, reclamation, or disposal. Because collectors often make a decision to either refurbish/reuse CRTs or to dispose of them, they frequently trigger the hazardous waste regulations, becoming potentially regulated generators when opting to send CRTs for disposal, reclamation, or recycling. Like original users, collectors are unregulated if they send CRTs to entities (e.g., other collectors) that might refurbish/reuse them.

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The category of collectors covers a wide variety of entities. For example, this category includes establishments that primarily refurbish CRTs for reuse and also establishments that primarily dismantle CRTs for recycling. Collectors that primarily refurbish CRTs for reuse tend to be smaller organizations, including non-profit entities. Collectors that primarily recycle CRTs are typically small to medium for profit businesses. Since not all CRTs can be refurbished for reuse, the collectors that refurbish CRTs typically send unusable CRTs to collectors that primarily recycle CRTs. Some collectors that primarily recycle CRTs break and grind the CRTs to separate out the metal from the glass. Separating the metal from the glass also reduces the CRT management costs of the glass if it is sent to glass processors. The grinding process increases the density of the CRTs, thus reducing shipping costs, and also results in a better price from the glass processor. The collector category also includes brokers that arrange for large quantities of electronic equipment, including CRTs, to be sent to electronics recycling facilities or for export. This analysis assumes that collectors that are SQGs discard bare CRTs and collectors that are LQGs discard broken or crushed CRT glass.[1] Collectors are assumed not to generate hazardous waste other than CRTs.

Current RCRA Regulatory Requirements

Under current EPA policy, CRTs that are discarded are assumed to be products and not wastes if there is the possibility that the CRTs will be refurbished or reused. Therefore, under current requirements, collectors that discard intact CRTs are only regulated generators if they send the CRTs for intended disposal (e.g., a landfill), to a lead smelter, or to a glass processor that does not refurbish any of the CRTs it receives. Collectors that discard bare CRTs or broken CRT glass are regulated generators regardless of where they are sent because it is assumed they cannot be reused at this point.[2]

Collectors are regulated if they produce hazardous wastes in quantities above a threshold of 100 kilograms (kg) per month. Collectors that produce less than 100 kg per month of hazardous waste are conditionally exempt from RCRA requirements and are not included in this analysis (40 CFR §261.5). Collectors that produce between 100 and 1,000 kg per month of hazardous waste are small quantity generators (SQGs) and must comply with storage limits, manifesting, recordkeeping, and safety training requirements (40 CFR Part 262 generally). Collectors that generate more than 1,000 kg per month of hazardous waste are large quantity generators (LQGs) and must comply with the same or more stringent requirements as SQGs and must also comply with biennial reporting requirements.

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[1] Collectors that are SQGs are assumed to not crush the CRTs because the large capital costs of the crushing equipment and the relatively low volumes of CRTs that they handle does not make crushing economically viable. Collectors that are LQGs are assumed to crush the CRTs because the larger volumes of CRTs they handle combined with the disposal cost savings for crushed versus whole bare CRTs makes the purchase and operation of the crushing equipment economically feasible.

[2] Bare CRTs are televisions or monitors that have had the casing, electronics, and electron gun removed from them, leaving only the panel and funnel glass that are still fused together.

Primary and CSI Alternatives

Under the primary alternative, bare intact CRTs that are sent to lead smelters and glass processors (see Sections 2.4 and 2.5) are unconditionally excluded from the definition of solid waste. Used broken CRTs are conditionally excluded when stored in containers or buildings. Therefore, the collectors that send CRTs to these disposal options are no longer considered generators of CRTs. Collectors that send their CRTs for disposal continue to be generators under the primary alternative.

Under the CSI alternative, CRTs that are sent to glass processors (see Section 2.5) are excluded from the definition of solid waste. Consequently, the collectors that send CRTs to glass processors are no longer considered generators of CRTs. Collectors that send their CRTs for disposal or to lead smelters continue to be generators under the CSI alternative. Thus, the CSI alternative reduces the number of collectors subject to the rule, but not by as many as does the primary alternative.

2.4 Reclaimers

Current RCRA Regulatory Requirements

Current requirements do not recognize or specifically define any category of CRT reclaimers.

Under current RCRA Subtitle C regulations, entities that disassemble televisions or computer monitors and break CRT glass for land disposal or smelting are "treating" the CRT glass (40 CFR § 260.10). Treatment of hazardous waste is often subject to administrative and technical standards and requires a permit (40 CFR Parts 264, 265, and 270). However, some forms of treatment, such as reclamation, are not subject to regulation (e.g., CRT disassembly for smelting) (40 CFR § 261.6(C)(1)) or, treatment may be conditionally exempt if the treater generated the waste (40 CFR §§ 262.34, 264.1(g)(3), and 265.1(c)(7)).

Primary and CSI Alternatives

Reclaimers include entities that use CRT glass as a substitute for raw materials. Under the primary alternative only lead smelters are recognized as reclaimers. Other types of reclaimers that are not recognized under the primary alternative include establishments that turn the CRT glass into a usable product, such as glass construction blocks. Another example is a reclaimer that has a value added process that turns the CRT glass into a marketable product called LeadX, which can be used as a sand-blasting abrasive suitable for the abatement of leaded paint.[3] The primary alternative only changes the RCRA regulatory requirements for lead smelters, but not for other types of reclaimers. The CSI alternative does not change the RCRA regulatory requirements for any reclaimers.

[3] Cutter Information Corp.'s, Product Stewardship Advisor, "The Long-Term Future of CRT Glass Recycling: How NEC Is Planning Ahead." Volume I, No. 6, November 1997.

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2.5 Glass Processors

Current RCRA Regulatory Requirements

Current requirements do not define any category of CRT glass processors. CRT glass processors are currently captured under the regulations as treatment, storage, and disposal facilities unless they also conduct refurbishment.

Primary and CSI Alternatives

Glass processors disassemble the televisions and computer monitors, intentionally break the CRT glass and prepare the CRT glass, by cleaning and sorting it, for shipment to CRT glass manufacturers. Glass processors receive discarded post-consumer televisions and computer monitors from both original users and collectors, and off-specification pre-consumer CRTs from manufacturers of televisions and computer monitors.[4] Although a subset of collectors perform some of the same processing steps as glass processors, the primary difference between glass processors and collectors is that glass processors prepare the glass for input directly into a CRT glass manufacturers furnace, while CRT glass from collectors requires further processing before it can be sent to a CRT glass manufacturer.

2.6 Transporters

Current RCRA Requirements

Under current requirements, transporters of any hazardous waste, including discarded CRTs, are required to be certified as hazardous waste handlers. (40 CFR Part 263)

Primary and CSI Alternatives

Under both regulatory alternatives, any non-hazardous material carrier may transport whole televisions and computer monitors between original users and collectors and between generators and glass processors without being certified hazardous waste handlers. Under the primary alternative, any non-hazardous material carrier may transport intact or broken CRTs between generators and reclaimers and between glass processors and reclaimers.

2.7 CRT Handlers

Current RCRA Regulatory Requirements

Current requirements do not recognize or define any category of CRT handlers.

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[4] Pre-consumer CRTs are not addressed in this analysis.

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Primary Alternative

The primary alternative does not recognize or define a category of CRT handlers.

CSI Alternative

The CSI alternative defines handlers as including entities that collect and/or store whole televisions or computer monitors, including those generated by the entity itself, and then send them to glass-to-glass recycling facilities (also called "glass processors") or to other handlers. Handlers also include any entity that disassembles televisions and computer monitors and sends the whole CRTs to a processor or another handler. Note that, under the CSI alternative, entities that are generators under current requirements become handlers for CRTs if they send their CRTs to glass-to-glass recycling facilities or to other handlers. Under the CSI alternative, handlers are exempt from RCRA generator requirements. *Large quantity handlers* (LQH) include handlers that collect and store more than 40 tons of CRTs for more than seven consecutive days. *Small quantity handlers* (SQH) include handlers that collect or store more than 100 kg per month. Handlers are believed to send CRTs to processors, smelters, or other handlers.

3.0 Methodology and Data

This section describes the methodology used to quantitatively estimate (1) the type and number of entities impacted by the proposed rule; (2) the cost savings expected to result from the proposed rule; and (3) the impact on the regulated entities. To obtain these results the analysis models the flow of discarded CRTs from generation to final disposal. The following ten steps broadly outline the analytical methodology:

(1) Estimate the number of original users discarding computer monitors;
(2) Estimate the total number of color computer monitors discarded annually;
(3) Estimate the number of regulated original users and collectors;
(4) Estimate the flow of discarded CRTs to each disposal alternative;
(5) Estimate the administrative compliance costs for the regulated establishments;
(6) Estimate the CRT management costs (i.e., costs for disposal, recycling, reuse);
(7) Estimate the transportation costs for shipping CRTs;
(8) Estimate the storage costs for storing CRTs;
(9) Estimate the costs for glass-to-glass processors and transporters; and
(10) Estimate the impact of the compliance costs on the regulated establishments.

These steps, along with the applicable data and assumptions used, are described below in Sections 3.1 through 3.10. Section 3.11 describes the methodology, data, and assumptions used to analyze the Subtitle D management baseline where a large percentage of CRTs are disposed in Subtitle D landfills without treatment. This baseline may more closely represent current CRT disposal practices. Section 3.12 identifies key assumptions and limitations of the methodology and data. It is worth noting at this time that the CRTs from televisions are addressed only in a sensitivity analysis presented in

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Sections 4.2.4 and 4.3.4. For reasons discussed in Section 3.12, this is not believed to have a significant bearing on the results.

While not a limitation to the analysis, note also that the analysis reflects generators of non-CRT hazardous wastes only to the extent that these entities generate more than 30 CRTs per year. For reasons discussed in Section 3.12, this is consistent with least cost behavior on the part of these entities.

3.1 Estimate the Number of Original Users Discarding Computer Monitors

Computers are used in all industries; it is rare to find a business establishment without at least one computer. However, businesses utilize computers at different rates. For example, financial institutions are far more likely to have high ratios of computers per employee than are farms. Given that computers are used, and therefore discarded, by virtually all establishments, the total number of establishments in all two-digit SIC codes provides an estimate of the number of business original users discarding computer monitors. These data are currently available for 1995 from the U.S. Bureau of the Census. The total number of establishments in all SIC codes in 1995 is 6,613,188. In addition to obtaining the total number of establishments in each two-digit SIC code, the distribution of establishments by size, as measured by the number of employees per establishment, was obtained for use in subsequent steps in the modeling process. Appendix A contains a table of the number of establishments and the total number of employees for all two-digit SIC codes.

3.2 Estimate the Total Number of Color Computer Monitors Discarded Annually

The second step in the modeling process estimates the number of color computer monitors discarded by the original users identified in the first step. To do this, the analysis estimates, in turn, the total number of computers in use, the number discarded each year and, finally, the number of these discarded monitors that are color monitors.

3.2.1 Total Number of Computers in All Business Establishments

To determine the total number of computers in use by all original users, an estimate of the ratio of computers per employee is developed for each two-digit SIC code based on two surveys taken by the U.S. Bureau of the Census.[5] The first survey, completed in 1993, contained a detailed listing of computer use at work by two-digit SIC classification. The second survey, completed in 1997, only contained a summary of computer use at work by fifteen major SIC classifications. This analysis uses the less detailed 1997 survey to extrapolate the more detailed 1993 survey results to 2001 by assuming the same percentage increase occurred between 1997 and 2001 as occurred from 1993 to 1997. This assumes a linear growth in computer use. The average increase in the percent of employees using

[5] U.S. Bureau of the Census, "Computer Use in the United States: October 1993." www.census.gov/population/socdemo/computer/compwork.txt and "Computer Use in the United States: October 1997." September 1999.

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computers is six percent. The range of percentage increases in the percent of employees using computers at work is from one to 14 percent. Appendix B lists the ratios of computers per employee calculated for each SIC code. The ratios are multiplied by the total number of employees in each two digit SIC code. The resulting products are summed to obtain an estimate of the total number of computers in use by all original users. The model estimates there are 55,555,000 computers used by all original users.

3.2.2 Discarded Computer Monitors from All Original Users

To determine the total number of computers discarded by all original users, the estimated number of computers in use by all original users is divided by an estimate of the average computer monitor life. The analysis assumes that computer monitors last an average of 3.5 years in businesses. A literature search yielded a wide range of estimates for monitor lifetimes. For example, a 1997 study by Carnegie Mellon suggested lifetimes of four to five years,[6] while a 1999 report by the National Safety Council estimates that monitor lifetimes would be 2.8 years in the year 2000.[7] The model results are sensitive to monitor lifetime. The estimated total number of computers discarded per year by all original users is 15,873,000. This value includes monitors that are sent by original users to organizations that will reuse the monitors.

An implicit assumption in this calculation is that businesses discard computers continuously, or in small batches annually, rather than replacing all computers once every 3.5 years. This is a reasonable assumption as most businesses purchase new computers on an as needed basis, and the computer stock in any one company is not all of the same age.

3.2.3 Color Monitors Discarded from All Original Users

To determine the total number of color monitors discarded, the model subtracts out laptop computers (which do not use CRTs) and monochrome monitors (which do not use glass with high lead concentrations) from the total number of computers discarded.[8] After these subtractions, described

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[6] Matthews, Scott H., McMichael, Francis Co., Hendrickson, Chris T., Hart, Deanna, J., *Disposition and End-of-Life Options for Personal Computers*, Carnegie Mellon University: Green Design Initiative Technical Report #97-10, July 7, 1997.

[7] National Safety Council, *Electronic Product Recovery and Recycling Baseline Report, Recycling of Selected Electronic Products in the United States*. May 1999. page 29.

[8] Monochrome computer monitors are assumed not to contain enough lead to qualify them as hazardous waste when discarded and thus are excluded from the analysis. Source: Overview of Cathode Ray Tube Recycling, February 27, 1997, page 8. The original source in the referenced report is a letter from Robert Dodds, Sony, to Nancy Helm, EPA Region X, dated July 8, 1996.

below, the resulting number of color monitors discarded per year by all original users is estimated at 11,714,000.

Percent of Discarded Computers that are Laptops. The model assumes that 18 percent of all discarded computers are laptops. Laptops have become an important segment of the computer market over the last five to eight years. Computer sales estimates from 1998 indicate that 18 percent of computer sales are laptops.[9] The model results are only slightly sensitive to the percent of laptops discarded.

Percent of Discarded Monitors that are Color. The Census survey from 1993 reported that 61 percent of *households* with computers have color monitors.[10] This analysis considers that figure to be a lower-bound estimate for businesses, based on the assumption that businesses are more likely to have color monitors than households. Since color monitors have become much more common over the last eight years, the model uses an estimate of 90 percent for the percent of color monitors discarded from businesses. The model results are sensitive to the percent of color monitors assumed as a percentage of all monitors discarded.

3.3 Estimate the Number of Regulated Original Users and Collectors and the Number of CRTs They Discard

The next step in the methodology is to determine the number of original users and collectors that are subject to RCRA requirements for generators and that would be affected by the regulatory alternatives. This section also estimates the number of CRTs that are discarded by original users and collectors. To complete these calculations, the number of computers discarded per establishment and an estimate of monitor weight is required. The report then explains the methodologies used to estimate the number of establishments for three types of entities: original users that are currently generators solely due to CRTs; original users that are generators due to a combination of CRTs and non-CRT hazardous waste; and collectors that are currently generators.

3.3.1 Computers Discarded per Original User

To estimate the average number of computers discarded annually per original user in each of the two digit SIC codes, the analysis estimates the average number of employees per establishment,

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[9] National Safety Council, *Electronic Product Recovery and Recycling Baseline Report, Recycling of Selected Electronic Products in the United States*. May 1999. page 31.

[10] U.S. Bureau of the Census, "Computer Use in the United States: October 1993." www.census.gov/population/socdemo/computer/compwork.txt.

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multiplies this estimate by the number of computers per employee (as discussed in Section 3.2.1), and then adjusts for the number of color computer monitors discarded. Exhibit 3-1 contains the summary statistics generated by this analysis for the number of color CRTs discarded per original user for all two-digit SIC codes.

The Census reports the number of establishments by two-digit SIC code for six size ranges of employees (250 to 499; 500 to 999; 1,000 to 1,499; 1,500 to 2,499; 2,500 to 4,999; and 5,000 or more employees). The midpoint of each range is used as the estimate of the number of employees in each establishment within each defined size range. For the largest category (5,000 or more employees), a value of 10,000 employees per establishment is used.

Exhibit 3-1: Number of Color CRTs Discarded per Original User for All Two-Digit SIC Codes

Statistic	Number of Color CRTs Discarded by Establishment Size As Determined by the Number of Employees					
	250 - 499	500 - 999	1000 - 1,499	1,500 - 2,499	2,500 - 4,999	> 5,000
Minimum	13	25	42	66	124	330
25th Percentile	32	34	107	172	321	854
Median	35	70	117	187	350	931
Average	43	85	141	225	422	1,123
75th Percentile	56	111	184	294	552	1,470
Maximum	79	157	261	417	781	2,082

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3.3.2 Monitor Weight

Throughout the analysis, the model assumes an average monitor weight of 35 pounds, based on the percentage and weight of each size of monitor sold 3.5 years prior to the modeled year.[11] The analysis uses a weighted average of the monitors sold in 1997 and 1998 to determine the average weight of monitors discarded in the model year. In the future, the average monitor weight is expected to increase with the use of larger screens, which would tend to push more original users into the regulated universe. For example, by 2004 the average weight of discarded monitors is expected to be 38 pounds.

3.3.3 Number of Original Users and Collectors that are Regulated Generators in the Subtitle C Baseline Based Only on the Generation of CRTs

Original Users

To estimate the number of original users that are regulated solely due to their generation of CRTs, assumptions must be made regarding the behavior that establishments will exhibit in discarding computer monitors. The analysis assumes that businesses will exhibit least cost behavior to the extent possible by discarding monitors each month just below the 100 kilogram per month limit for SQGs. An original user becomes an SQG if in any one month it exceeds the 100 kilogram per month threshold.

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[11] The table below presents the number and percent of monitors sold in 1997 and 1998 by size of monitor. The source of the sales data is the Electronic Industries Alliance report, Spring 2001. The 15-inch monitor weight was obtained from the user manuals for a Sony Trinitron Color Computer Display (manufactured in 1998), and for an Apple Multiple Scan 15 Display (manufactured in 1994). The 17-inch monitor weight was obtained from the user manual for a Sony Trinitron Color Computer Display (manufactured in 1998). The 14-inch and 19- to 21-inch monitor weights are estimated based on the weight of glass in each monitor size, which is 20 pounds and 28 pounds respectively

Monitor Size (inches)	Monitor Weight (lbs)	1997		1998	
		Number Sold	Percent Sold	Number Sold	Percent Sold
< = 14	26	4,100	14%	2,600	8%
15	31	12,800	45%	12,900	41%
17	41	10,300	36%	13,700	43%
19 - 21	48	1,200	4%	2,400	8%
Totals		28,400	100%	31,600	100%

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Based on the current SQG threshold (100 kg/month) and LQG threshold (1,000 kg/month) under the Subtitle C baseline, and the assumptions made regarding monitor lifetime and weight, and the assumed least cost behavior, original users who discard 73 - 744 monitors annually are SQGs and those who discard 745 or more monitors annually are LQGs.[12] Based on the assumed monitor lifetime of 3.5 years, the smallest SQG possesses 256 operating color computer monitors and the smallest LQG possesses 2,608 operating color computer monitors. Under these assumptions and the estimated number of computers discarded per establishment, there are an estimated 12,151 potential SQGs and 356 potential LQGs in the Subtitle C baseline due solely to the generation of CRTs. These entities discard an estimated total of 2,490,000 CRTs per year. Some of these potential SQGs and LQGs only send CRTs to collectors, for reuse, or to glass processors who refurbish and resell some of the monitors they receive. Thus not all of the potential SQGs and LQGs are actually regulated generators. The analysis estimates that there are 2,066 actual SQGs and 61 actual LQGs. The analysis models the flow of all of the CRTs generated by all the potential original user generators, because although the establishments generating these CRTs are not regulated, the CRTs themselves may still become subject to regulation with subsequent handlers.

Collectors

To estimate the number of collectors the analysis started with a database of establishments involved in the electronics recycling industry.[13] By comparing this database with the names of electronics recyclers mentioned in the literature review, a rough estimate of the number of collectors was obtained. The analysis estimates there are 100 potential SQGs and 500 potential LQGs that are collectors. Collectors are assumed to only be hazardous waste generators due to their discarding of CRTs. The 600 potentially regulated collectors are estimated to process approximately 2.0 million CRTs per year. Some of these potential collectors only send CRTs for reuse or for export, neither of which are regulated activities if the CRTs have the possibility of being reused. Thus, the collectors who send CRTs for reuse or export are not considered regulated generators in this analysis. The analysis assumes that there are 50 SQGs and 250 LQGs.

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[12] This calculation assumes that, in any one month, an establishment will be subject to RCRA regulation if it discards seven or more color monitors (7 monitors * 15.9 kg/monitor = 111 kg; 100 kg per month is the threshold for SQGs). Assuming least-cost behavior, the smallest number of color monitors an establishment could discard annually and trigger the RCRA requirements for SQGs is [(11 months * (7-1 CRTs)) + (1 month * 7 CRTs) =] 73 CRTs per year. Given the assumed monitor lifetime (3.5 years, for a turnover rate of 0.29), SQGs must possess a minimum of 73/0.29, or 256 operating color monitors. The numbers for LQGs are calculated using the same method, with the threshold for discard starting at 63 color monitors per month, or 745 in a year, for a total number of computers of 2,608 in each LQG establishment.

[13] The database is the International Association of Electronics Recyclers (IAER) industry directory that is located on IAER's web site, www.iaer.org.

3.3.4 Number of Original Users that are Regulated Generators in the Subtitle C Baseline Due to a Combination of CRTs and Non-CRT Hazardous Waste

The number of generators due in part to non-CRT hazardous waste is estimated from the number of original users discarding between 30 and 72 CRTs per year and the total number of SQGs and LQGs in each two-digit SIC code. The lower bound of 30 CRTs discarded per year is based on the assumption that generators discarding fewer than 30 CRTs per year do not send their CRTs to glass-to-glass processors due to the high transportation costs and low volume of CRTs discarded. The upper bound of 72 CRTs discarded per year is used because original users generating more than 72 CRTs per year are captured as SQGs or LQGs in the analysis above.

The total number of all original users discarding between 30 and 72 CRTs per year in each two-digit SIC code is estimated using the same methodology as described in Sections 3.3.1 to 3.3.3. The total number of original users generating between 30 and 72 CRTs per year is estimated at 21,842. This number underestimates the total number of these generators because for some SIC codes the number of employees that generate 30 CRTs per year is less than 250, while the analysis uses the total number of establishments with 250 to 499 employees to estimate the number of generators. The analysis uses this larger size category because the Census data source does not have a category for below 250 employees except for 1 - 249 employees. Because about 97 percent of all establishments have less than 250 employees, it is likely that the estimated number of establishments discarding 30 to 72 CRTs is low. To estimate the number of hazardous waste generators in each two-digit SIC code from the number of all establishments discarding 30 to 72 CRTs per year, the ratio of all hazardous waste generators to all establishments in each two-digit SIC code is multiplied by the total number of establishments discarding between 30 and 72 CRTs per year.[14] To account for the fact that SQGs and LQGs are more likely to be larger organizations, the ratio for SQGs is multiplied by a factor of 1.5 and the ratio for LQGs is multiplied by a factor of 2. Under these assumptions there are 2,136 potential SQGs and 891 potential LQGs because they generate a combination of CRTs and non-CRT hazardous waste. These generators discard an estimated total of 151,000 CRTs per year. Some of these potential SQGs and LQGs only send CRTs to collectors, so not all of the potential SQGs and LQGs are actually regulated generators. The analysis estimates that there are 534 actual SQGs and 223 actual LQGs. The total number of original user generators under the baseline is estimated at 2,600 SQGs and 284 LQGs.

A list of the number of SQG and LQG original users by two-digit SIC code under the Subtitle C baseline and the proposed rule is shown in Exhibit 3-2. Under the baseline there are generators in 66 different two-digit SIC codes.

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[14] The ratio of all hazardous waste generators to all establishments was calculated from data obtained from the biennial reporting system database (number of LQGs) and the Resource Conservation and Recovery Information System (RCRIS) database (number of SQGs in each SIC code) and 1995 U.S. Census data.

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3.3.5 Number of Original Users and Collectors that are Regulated Generators Under the Primary Alternative

Under the proposed rule, the generators under the baseline that send their monitors to glass processors or reclaimers are no longer regulated as generators of hazardous waste. However, the baseline generators, whether original users or collectors, that continue to send monitors for hazardous waste disposal will be subject to full RCRA Subtitle C regulation and will qualify as SQGs or LQGs at the RCRA thresholds of 100 and 1,000 kilograms of CRTs generated per month, respectively.

The analysis assumes that two percent of original users (both SQGs and LQGs) will send their monitors for disposal under the primary alternative. This assumption is based on the high costs associated with disposal of intact CRTs and anecdotal evidence regarding the current disposal practices. For original users under this assumption, there are 286 SQGs, 25 LQGs, and 2,573 former generators under the primary alternative. For collectors, the analysis assumes that 80 percent of collectors will continue to send at least one shipment per year for disposal. Thus the analysis estimates there are two SQG collectors, ten LQG collectors, and 288 former generators that are collectors under the primary alternative.

Exhibit 3-2: Original User Generators Under the Baseline by 2-digit SIC Code

Industry	SIC Code	Potential SQG Establishments			Potential LQG Establishments		
		Due to CRTs Only	Due to Other Haz. Waste	Total	Due to CRTs Only	Due to Other Haz. Waste	Total
AGRICULTURE							
Agriculture service	7	1	0	1	0	0	0
Forestry	8	2	0	2	0	0	0
MINING							
Metal mining	10	24	7	31	0	1	1
Coal mining	12	21	6	27	0	1	1
Oil & gas extraction	13	52	6	58	0	1	1
Non-metallic minerals, except fuels	14	5	1	6	0	0	0
Administrative & auxiliary	-	37	7	44	0	1	1
CONSTRUCTION							
General contractors	15	8	0	8	0	0	0
Heavy construction	16	24	1	25	0	1	1
Special trade contractors	17	5	0	5	0	0	0
Administrative & auxiliary	-	0	1	1	0	0	0
MANUFACTURING							
Food & kindred products	20	178	139	317	3	13	16
Tobacco products	21	10	9	19	1	2	3
Textile mill products	22	56	44	100	0	5	5

Industry	SIC Code	Potential SQG Establishments			Potential LQG Establishments		
		Due to CRTs Only	Due to Other Haz. Waste	Total	Due to CRTs Only	Due to Other Haz. Waste	Total
Apparel & other textile products	23	9	2	11	0	0	0
Lumber & wood products	24	3	1	4	0	0	0
Furniture & Fixtures	25	30	18	48	0	6	6
Paper & allied products	26	208	119	327	0	32	32
Printing & publishing	27	328	56	384	0	9	9
Chemicals & allied products	28	297	192	489	4	159	163
Petroleum and coal products	29	44	23	67	0	12	12
Rubber & misc. plastics products	30	225	122	347	0	38	38
Leather & leather products	31	5	2	7	0	1	1
Stone, Clay, and glass products	32	22	8	30	0	2	2
Primary metal industries	33	72	221	293	5	150	155
Fabricated metal products	34	62	251	313	0	112	112
Industrial machinery & equipment	35	483	123	606	7	19	26
Electronic & other electronic equipment	36	578	309	887	12	133	145
Transportation equipment	37	459	202	661	51	100	151
Instrument & related products	38	121	28	149	0	11	11
Miscellaneous manufacturing	39	19	7	26	0	2	2
Administrative & Auxiliary	-	212	4	216	0	1	1
TRANSPORTATION							
Local & Interurban passenger transit	41	7	5	12	1	1	2
Trucking & Warehousing	42	98	12	110	12	2	14
Water transportation	44	16	4	20	0	0	0
Transportation by Air	45	78	15	93	20	5	25
Pipelines, except natural gas	46	1	1	2	0	1	1
Communication	48	303	0	303	11	0	11
Electronic, gas, & sanitary services	49	255	81	336	4	55	59
Administrative & Auxiliary	-	43	3	46	5	1	6
WHOLESALE							
Wholesale trade-durable goods	50	168	6	174	0	0	0
Wholesale trade-nondurable goods	51	213	7	220	0	3	3
Building materials & garden supplies	52	1	0	1	0	0	0
Administrative & Auxiliary	-	98	5	103	1	1	2
RETAIL TRADE							

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Industry	SIC Code	Potential SQG Establishments			Potential LQG Establishments		
		Due to CRTs Only	Due to Other Haz. Waste	Total	Due to CRTs Only	Due to Other Haz. Waste	Total
General merchandise store	53	28	23	51	0	1	1
Food stores	54	2	1	3	1	0	1
Auto dealers & service station	55	1	6	7	0	0	0
Apparel & accessory stores	56	4	0	4	0	0	0
Furniture & home furnishing stores	57	2	0	2	0	0	0
Eating & drinking places	58	6	0	6	0	0	0
Miscellaneous retail	59	31	0	31	0	0	0
Administrative & Auxiliary	-	96	7	103	1	1	2
FINANCE, INSURANCE, AND REAL ESTATE							
Depository Institution	60	339	0	339	18	0	18
Nondepository Institution	61	87	0	87	5	0	5
Security & commodity brokers	62	86	0	86	5	0	5
Insurance carriers	63	482	0	482	14	0	14
Insurance agents, brokers, & servicers	64	27	0	27	0	0	0
Real Estate	65	74	0	74	0	0	0
Holding & other investment offices	67	37	0	37	3	0	3
Administrative & Auxiliary	-	23	6	29	0	1	1
SERVICES							
Personal services	72	6	1	7	0	0	0
Business services	73	1,432	20	1,452	22	5	27
Auto repair services & parking	75	1	2	3	0	0	0
Miscellaneous repair services	76	2	0	2	0	0	0
Motion picture	78	15	0	15	5	0	5
Amusement & recreation services	79	69	1	70	3	0	3
Health services	80	3,177	20	3,197	65	2	67
Legal services	81	52	0	52	0	0	0
Educational services	82	580	0	580	33	0	33
Social Services	83	18	0	18	0	0	0
Museums, botanical, zoological gardens	84	3	1	4	0	0	0
Membership organization	86	83	0	83	6	0	6
Engineering & management service	87	365	0	365	31	0	31
Services, n.e.c	89	8	0	8	0	0	0
Administrative & Auxiliary	-	134	0	134	7	0	7

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Industry	SIC Code	Potential SQG Establishments			Potential LQG Establishments		
		Due to CRTs Only	Due to Other Haz. Waste	Total	Due to CRTs Only	Due to Other Haz. Waste	Total
Total Original Users Under the Baseline		**12,151**	**2,136**	**14,287**	**356**	**891**	**1,247**
Total Number of Actual Original User Generators Under the Baseline		**2,066**	**534**	**2,600**	**61**	**223**	**284**
Total Number of Actual Original User Generators Under the Primary Alternative		**286 SQGs 2,314 Not Regulated**			**25 LQGs 259 Not Regulated**		
Total Number of Actual Original User Generators Under the CSI Alternative		**390 SQGs 2,452 SQHs**			**42 LQGs 0 LQHs**		

3.3.6 Number of Original Users and Collectors that are Regulated Generators Under the CSI Alternative

Under the CSI alternative, the original user generators under the baseline who send their monitors to glass processors become handlers. However, the baseline original user generators that continue to send monitors for disposal or to lead smelters will be subject to full RCRA Subtitle C regulation and will qualify as SQGs or LQGs at the RCRA thresholds of 100 and 1,000 kilograms of CRTs generated per month respectively.

The threshold for SQGs under the baseline is the same as for small quantity handlers (SQH) under the CSI alternative. However, the threshold for large quantity handler (LQH) status is much higher. For a handler to be regulated as an LQH under the proposed rule, the handler must store 36,287 kilograms of computer monitors (40 tons) for more than seven days. This is equivalent to 2,281 monitors, or an approximate total of 7,984 operating monitors on site.

The analysis assumes that a total of 17 percent of generators (both SQGs and LQGs) will send their monitors only to glass processors under the CSI alternative. This assumption is based on the fact that there are currently only several processors and thus transportation costs may be prohibitive in some areas of the country. Also smelters are likely to compete on price to obtain discarded monitors.[15] Lead smelters, in particular, value tipping fees from monitors as a secondary revenue source. The primary revenue source for lead smelters is the sale of refined lead. These factors will contribute to limiting the percentage of monitors that are sent for glass-to-glass recycling. Under the CSI alternative, all of the LQGs sending their discarded CRTs to processors are reclassified as SQHs because they do not exceed the higher threshold for LQHs. Under these assumptions, there are 390 SQGs, 42 LQGs, 2,452 SQHs, and no LQHs under the CSI alternative.

3.4 Flow of CRTs from Generators to Disposal Sites Under the Subtitle C Baseline

[15] See telephone interviews with Noranda and Doe Run in Appendix H.

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The analysis considers the flow of CRTs from original users, through collectors, reusers, and glass processors, and on to treatment and disposal destinations. Exhibit 3-3 presents a simplified diagram of this flow under the Subtitle C baseline, which shows how CRTs flow from original users to the final CRT management options. The exhibit shows that the CRT management options for original users include collectors, establishments that reuse CRTs, hazardous waste treatment and disposal facilities, reclaimers, and glass processors. The CRT management options for collectors include establishments that reuse CRTs, hazardous waste treatment and disposal facilities, reclaimers, and glass processors. The CRT management options for glass processors include reclaimers and CRT glass manufacturers. The actual flows modeled for this baseline are presented in Exhibit 3-4.

The analysis recognizes that either of the two regulatory alternatives will provide incentives for behavioral changes and will result in altered flows. Exhibit 3-5 shows the flows assumed to occur under the primary alternative. It reflects all CRTs that are regulated in the baseline, even though many of them will be unregulated post-rule. Similarly, Exhibit 3-6 shows the flows assumed to occur under the CSI alternative, including flows to and from the "handlers" that will be unregulated under that alternative. These three exhibits show the estimated percentages for the flow of CRTs from each type of entity to each of the various CRT management options, and the total tons of CRTs sent from each type of entity. Thus, the total tons of CRTs generated multiplied by each percentage yields the tons of CRTs sent from each type of generator to each CRT management option. These three exhibits also show, for reference purposes, representative disposal costs for each CRT management option to provide an indication of the comparative economic advantage of sending CRTs to each CRT management option.

Collectors and glass processors are only intermediaries in the flow of CRTs towards their ultimate disposal endpoint. Thus all of the CRTs that collectors and glass processors receive are expected to be sent to other entities. Although reuse is not the ultimate disposal endpoint for CRTs, within the one year time frame of this analysis, CRTs that are sent for reuse are not expected to be discarded again, since the expected lifetime of a reused CRT is two to four years.[16]

Exhibit 3-3: CRT Life-Cycle Flow Diagram

[16] National Safety Council, *Electronic Product Recovery and Recycling Baseline Report, Recycling of Selected Electronic Products in the United States*. May 1999.

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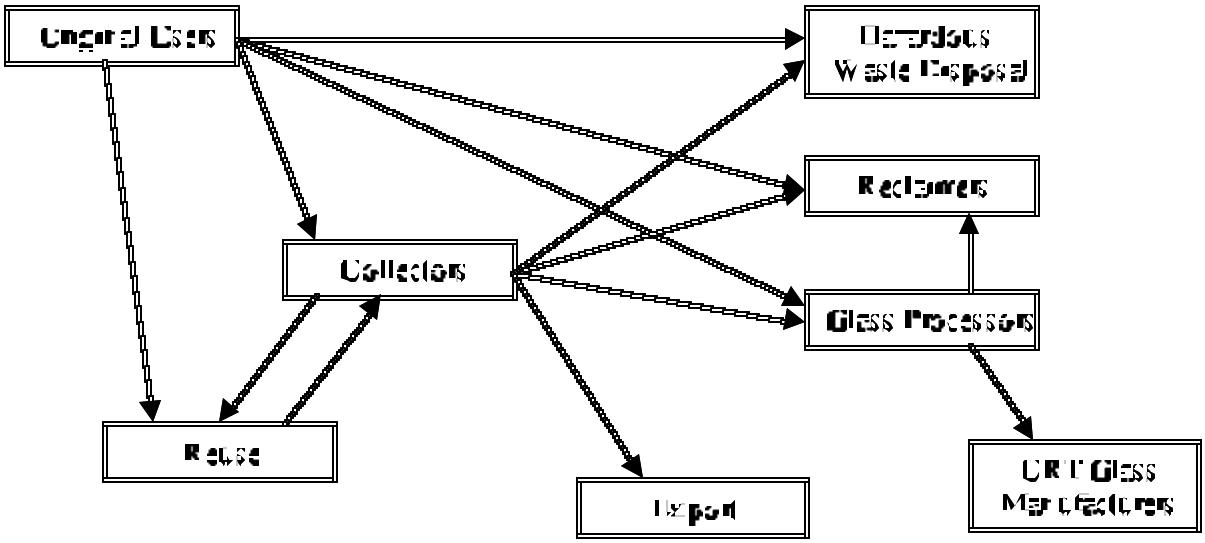

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Exhibit 3-4: Assumed Distribution of Discarded Monitors and CRT Glass Under the Subtitle C Management Baseline

Entity Distributing CRTs	Reuse	Export	Intermediate Processors		Disposal Options			Total Percent	Total Tons Disposed
			Collector	Glass Processor	Hazardous Waste Facility	Reclaimer	CRT Glass Manufacturer		
Disposal Cost*	$0/ton (I)	$100/ton (I)	$271/ton (I)	$333/ton (I) $0/ton (C)	$1,500/ton (I) $160/ton (C)	$207/ton (I) $152/ton (C)	- $175/ton (C)		
Original User SQGs and LQGs									
Due to CRTs Only	2% (I)	0%	76% (I)	5% (I)	2% (I)	15% (I)	NA	100%	43,577
Due to CRTs and Non-CRT Hazardous Waste	0% (I)	0%	75% (I)	0%	25% (I)	0%	NA	100%	2,647
Collectors									
SQGs	20% (I)	30% (I)	NA	25% (B)	2% (B)	23% (B)	NA	100%	2,925
LQGs	20% (I)	30% (I)	NA	30% (C)	10% (C)	10% (C)	NA	100%	32,178
Glass Processors	0%	0%	NA	NA	0%	2% (C)	98% (C)	100%	7,358
Total Tons	7,892	10,531	35,104	7,538	3,499	9,022	7,387		

* Disposal costs shown are representative simplifications of the actual costs used in the analysis. See Exhibit 3-10 for further details.
(I) = Intact whole monitors.
(B) = Bare CRTs without the casing.
(C) = Crushed CRT glass.
NA = Not Applicable.

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Exhibit 3-5: Assumed Distribution of Discarded Monitors Under the Primary Alternative

Entity Distributing CRTs	Reuse	Export	Intermediate Processors		Disposal Options			Total Percent	Total Tons Disposed
			Collector	Glass Processor	Hazardous Waste Facility	Reclaimer	CRT Glass Manufacturer		
Disposal Cost*	$0/ton (I)	$100/ton (I)	$271/ton (I)	$333/ton (I) $0/ton (C)	$1,500/ton (I) $160/ton (C)	$207/ton (I) $152/ton (C)	- $175/ton (C)		
Original Users									
SQGs and LQGs	NA	NA	NA	NA	2% (I)	NA	NA	100%	46,224
Former SQGs and LQGs	2% (I)	0%	76% (I)	5% (I)	NA	15% (I)	NA		
Collectors									
Regulated Post-Rule									
SQGs	20% (I)	30% (I)	NA	25% (B)	2% (B)	23% (B)	NA	100%	59
LQGs	20% (I)	18% (I)	NA	45% (C)	2% (C)	15% (C)	NA	100%	648
Unregulated Post-Rule									
Former SQGs	20% (I)	30% (I)	NA	25% (B)	NA	25% (B)	NA	100%	2,886
Former LQGs	20% (I)	18% (I)	NA	45% (C)	NA	17% (C)	NA	100%	31,743
Glass Processors	0%	0%	NA	NA	0%	2% (C)	98% (C)	100%	10,546
Total Tons	7,973	6,714	35,335	10,546	931	10,743	10,335		

* Disposal costs shown are representative simplifications of the actual costs used in the analysis. See Exhibit 3-10 for further details.
(I) = Intact whole monitors.
(B) = Bare CRTs without the casing.
(C) = Crushed CRT glass.
NA = Not Applicable.

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Exhibit 3-6: Assumed Distribution of Discarded Monitors Under the CSI Alternative

Entity Distributing CRTs	Reuse	Export	Intermediate Processors		Disposal Options			Total Percent	Total Tons Disposed
			Collector	Glass Processor	Hazardous Waste Facility	Reclaimer	CRT Glass Manufacturer		
Disposal Cost*	$0/ton (I)	$100/ton (I)	$271/ton (I)	$333/ton (I) $0/ton (C)	$1,500/ton (I) $160/ton (C)	$207/ton (I) $152/ton (C)	- $175/ton (C)		
Original Users									
SQGs and LQGs	NA	NA	NA	NA	15% (I)	85% (I)	NA	100%	6,926
Former SQGs and LQGs (SQHs and LQHs)	2% (I)	0%	88% (I)	10% (I)	NA	NA	NA	100%	39,298
Collectors									
SQGs	20% (I)	30% (I)	NA	25% (B)	2% (B)	23% (B)	NA	100%	2,882
LQGs	20% (I)	20% (I)	NA	45% (C)	2% (C)	13% (C)	NA	100%	31,701
Glass Processors	0%	0%	NA	NA	0%	2% (C)	98% (C)	100%	11,349
Total Tons	7,702	7,205	34,582	11,349	1,454	8,984	11,122		

* Disposal costs shown are representative simplifications of the actual costs used in the analysis. See Exhibit 3-10 for further details.
(I) = Intact whole monitors.
(B) = Bare CRTs without the casing.
(C) = Crushed CRT glass.
NA = Not Applicable.

Under the primary alternative, 3,008 additional tons of CRTs are sent to glass processors relative to the Subtitle C baseline. These CRTs are re-directed primarily from hazardous waste facilities (decrease of 2,568 tons) and from export (decrease of 3,817 tons) under the baseline. The 2,568 tons of CRTs diverted from landfills translates to a volume of 456,000 cubic feet. The tons of CRTs recycled under the primary alternative increases by 4,669 tons over the baseline.

Under the CSI alternative, 3,811 additional tons of CRTs are sent to glass processors relative to the Subtitle C baseline. These CRTs would go to hazardous waste facilities (decrease of 2,045 tons) and for export (decrease of 3,326 tons) under the baseline. The 2,045 tons of CRTs diverted from landfills translates to a volume of 351,000 cubic feet. The tons of CRTs recycled under the CSI alternative increases by 3,697 tons over the baseline.

Under the Subtitle C baseline, generators will send the minimum number of shipments to stay in compliance with hazardous waste accumulation limits. For small quantity generators, the storage limit is 180 days; these establishments will make two shipments per year. Large quantity generators have a storage limit of 90 days; they will make four shipments per year. Collectors are assumed to handle relatively larger volumes of CRTs and thus are assumed to ship CRTs when they have full loads or at least four times per year for LQGs and two times a year for SQGs. On average, collectors ship CRTs two and four times per year, respectively for SQGs and LQGs. Glass processors are also assumed to handle relatively larger volumes of CRTs and thus are assumed to ship CRTs when they have full loads or at least four times per year. On average glass processors ship CRT funnel and panel glass 67 and 96 times per year under the baseline and alternatives, respectively. Under the primary and CSI alternatives, each former generator is assumed to send discarded CRTs off-site once a year or more frequently if the volume of CRTs warrants increased shipment frequency.

3.4.1 Disposal Option Assumptions

The following assumptions are used to develop the estimates of the volume of discarded monitors being sent to each of the disposal alternatives (collectors, reuse, hazardous waste facilities, reclaimers, and glass processors):

Reuse. The analysis assumes that two percent of discarded CRTs from original users are sent for reuse in the Subtitle C baseline, and that this percentage remains constant under the primary and CSI alternatives. The percentage of CRTs sent for reuse by original users is assumed to be low for several reasons.

- Local organizations that can use donated computers are limited in number and need for computers. Most donated computers are used locally, although there is at least one foundation that sends donated computers worldwide for reuse.
- Businesses donating computers are concerned about proprietary information that may be left on hard drives. This concern reduces the number of computers that businesses donate.

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The analysis assumes that 20 percent of discarded CRTs from collectors are sent for reuse under the Subtitle C baseline, and that this percentage remains constant under the primary and CSI alternative. Collectors obtain a higher return on reused monitors than they do on disassembled monitors whose parts are recycled. Thus collectors have a strong economic incentive to resell monitors for reuse.

Exports. The analysis assumes that only collectors arrange for the export of CRTs and that only intact CRTs are exported. Under the baseline, collectors are assumed to export 30 percent of CRTs they receive. The literature search indicated that a large, but unknown, percentage of CRTs are exported.[17] Under the primary alternative collectors who are SQGs are assumed to continue to export 30 percent of the CRTs they receive, while LQGs are assumed to export 18 percent of the CRTs they receive. Collectors who are LQGs are assumed to export fewer CRTs under the primary alternative because LQGs have a greater economic incentive to send CRTs to a glass processor than to export them. Under the CSI alternative collectors who are SQGs are assumed to continue to export 30 percent of the CRTs they receive, while LQGs are assumed to export 20 percent of the CRTs they receive.

Collectors. Under the baseline, the analysis assumes that 76 percent of CRTs from original users are sent to collectors. CRTs going to collectors are consolidated, reused when possible, demanufactured and recycled, or refurbished. Although collectors are not the least expensive disposal option they become an economically attractive alternative when administrative and transportation costs are considered. Thus, most discarded CRTs are assumed to be sent to collectors. There are two factors that reduce the costs of sending CRTs to collectors. First, collectors are typically located near businesses, and thus the transportation costs are comparatively low. Second, CRTs sent to collectors are considered a product and not a waste and thus do not fall under RCRA control.

The collectors typically will consolidate the CRTs from various establishments and send them to reclaimers or glass processors. The collectors demanufacture the monitors and recycle the components that have value. The analysis assumes that LQG collectors have high enough volumes of CRTs to warrant purchasing glass crushing equipment. Thus all shipments of CRTs from LQGs to glass processors, hazardous waste facilities, and reclaimers are assumed to be crushed CRT glass, which has economic benefit. The baseline assumes that 30 percent of the CRTs the LQG collectors receive are crushed and sent to glass processors, 10 percent are crushed and sent to reclaimers, and 10 percent are crushed and sent to hazardous waste facilities. Crushing the CRTs significantly reduces the disposal costs charged by glass processors, reclaimers, and hazardous waste facilities. More CRTs are assumed to be sent to glass processors because the low disposal cost for crushed glass at glass processors often

[17] National Safety Council, *Electronic Product Recovery and Recycling Baseline Report, Recycling of Selected Electronic Products in the United States*. May 1999.

outweighs the higher transportation costs due to longer distances. As mentioned above, 20 percent of the regulated CRTs that collectors receive are refurbished and sold for reuse. Thirty percent of the CRTs received by collectors are assumed to be exported for reuse or recycling. Since SQG collectors do not crush the CRT glass they are assumed to send more CRTs to reclaimers than to hazardous waste facilities, because of the lower tipping fees at reclaimers. Under the regulatory alternatives the analysis assumes that more crushed CRTs are sent to glass processors because of the low tipping fees and absence of administrative costs. Similarly, more crushed CRTs are assumed to be sent to reclaimers and less are sent to hazardous waste facilities because of the administrative burden on CRTs sent to hazardous waste facilities.

Glass Processors. The analysis assumes that a relatively small percentage of CRTs from original users are sent directly to glass processors because of the higher disposal cost for intact CRTs and the relatively longer shipping distances. The analysis assumes that only businesses located near glass processors will send CRTs directly to them.

Hazardous Waste Facilities. The analysis assumes that original users, who are generators due to CRTs only, will send two percent of discarded CRTs to hazardous waste facilities in the Subtitle C baseline, and that this percentage remains at two percent under the primary alternative. Under the CSI alternative, 15 percent of CRTs from original users are assumed to be sent to hazardous waste facilities. Although the percent of CRTs sent to hazardous waste facilities is higher under the CSI alternative than the baseline, there is still a 60 percent reduction in the number of CRTs sent to hazardous waste facilities due to the smaller number of generators in the CSI alternative. Several contacts at one of the largest Subtitle C facilities in the United States, Chemical Waste Management, reported receiving no CRTs during 1998. Contacts at other commercial hazardous waste disposal facilities also report receiving few CRTs for disposal over the last couple of years.[18] However, a Tufts University study reports that 14 percent of CRTs are sent to landfills or municipal waste combustors. The Tufts data are believed to include monitors from households. Households are more likely to send their CRTs to landfills than are RCRA regulated establishments because households incur no direct costs to send monitors to Subtitle D landfills, but it is expensive for regulated generators to send monitors for treatment and disposal in Subtitle C or D landfills. Sending intact CRTs to a hazardous waste facility is more expensive than sending the CRTs to lead smelters or glass processors. Therefore, most CRTs ending up at hazardous waste facilities are probably originating in areas of the country without nearby lead smelters, glass processors, or collectors.

Reclaimers. The analysis assumes that under the Subtitle C baseline, 15 percent of CRTs from original users are sent directly to reclaimers and that this percentage remains constant under the

[18] Envirosafe Services of Ohio reported receiving no CRTs last year and approximately 20 to 30 tons the previous year. Clean Harbours in Massachusetts reported that they do receive CRTs, however, all of the CRTs they receive are processed in Clean Harbours Bristol Connecticut recycling facility and none are disposed.

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primary alternative. Lead smelters receive monitors from original users, collectors, and glass processors. Most reclaimed CRTs are sent to lead smelters; however, copper smelters also accept CRT glass. The glass is used as a fluxing agent in the smelting furnaces. Two references indicated that lead smelters take whole monitors, crush them, and then add the crushed monitor to the smelting furnace.[19] However, Noranda indicated that the monitor's plastic casing tends to foul their sulfuric acid plant, so they only accept the glass. Copper smelters put crushed or whole monitors into the smelting furnace to recover the copper from the electronics and use the glass as a fluxing agent. Glass processors send approximately two percent of the glass they receive to reclaimers.[20] This CRT glass is in the form of fines that cannot be sent to CRT glass manufacturers.

CRT Glass Manufacturers. Only glass processors are assumed to send recycled post consumer CRT glass to CRT glass manufacturers. Ninety-eight percent of the CRT glass that glass processors receive is sent to CRT glass manufacturers because of the quality requirements and technical specificaitons.

Monitor Shipping Size. A typical 15 inch monitor has a volume of 1.5 cubic feet.[21] Based on the assumption that discarded CRT monitors will be shipped carefully to avoid breakage of the CRT glass, the model includes the assumption that the monitors will, on average, occupy 3.0 cubic feet during shipment.[22] This includes approximately 0.3 cubic feet per monitor for the actual packing material, such as a pallet or box. Whole monitors or whole CRTs are placed on a pallet and wrapped in plastic, or are placed in one cubic yard boxes (Gaylord containers) to minimize breakage and to contain any broken glass during transport.

Truck Capacity. The maximum number of monitors that can be shipped in a truck by volume and weight is calculated to determine if the largest individual shipment from a generator or handler could be sent in one truck or would require two trucks. A truck volume of 4,280 cubic feet represents the volume of a semi-trailer measuring 9.5 by 53 by 8.5 feet, which is the largest standard for trailers. A truck of this size carries up to 1,426 monitors (based on the assumption that the shipping size of a monitor is 3.0 cubic feet). The maximum payload for standard trucks is about 23 tons, which is equivalent to 1,314 thirty-five pound monitors. Thus the truck weight limit is the limiting factor. The maximum number of CRTs that the largest establishments are

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[19] Doe Run indicated that they accept whole monitors. The article by Aanstoos, T., Mizuki, C., Nichols, S., and Pitts, G. *CRT Disposition: An Assessment of Limitations and Opportunities in Reuses, Refurbishment, and Recycling in the U.S.* (page 75) states that lead smelters accept whole monitors.

[20] Conversation with Greg Vorhees of Envirocycle, April 25, 2001.

[21] Sony Trinitron Color Computer Display (manufactured in 1998) owners manual.

[22] Based on a conversation with Chris Beyus of Clean Harbor.

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estimated to generate in one year is 2,082 (see Exhibit 3-1). Thus under the alternatives, where generators can accumulate CRTs up to one year, shipments from the largest generators would require two truckloads per year. Under the baseline it is assumed that all SQGs ship twice a year and that all LQGs ship four times per year. Under the primary alternative, for the generators that now send CRTs to glass processors or reclaimers and are thus eligible for regulatory relief, the model assumes that all former SQGs and former LQGs make the number of shipments per year that minimizes the total of their administrative, storage, and transportation costs. The analysis estimates that under the primary alternative former SQGS make one shipments and former LQGs make two shipments per year.

3.5 Estimate Administrative Compliance Costs

This section describes the administrative requirements and costs applicable to two groups of generators (i.e., generators due solely to CRTs and generators due to non-CRT hazardous wastes) under the baseline and the primary and CSI alternatives. Disposal costs, transportation costs, and storage costs in the baseline and under each alternative are addressed in Sections 3.6, 3.7, and 3.8, respectively.

3.5.1 Baseline Unit Costs for Original Users (Generating No Non-CRT Hazardous Waste)

The analysis models the current management of discarded CRTs assuming 100 percent compliance with RCRA Subtitle C requirements under the Subtitle C baseline. Administrative activities required under Subtitle C and the associated unit costs are summarized in Exhibit 3-7.

3.5.2 Baseline Unit Costs for Original Users Also Generating Non-CRT Hazardous Waste

The analysis models the current management of discarded CRTs assuming 100 percent compliance with RCRA Subtitle C requirements under the Subtitle C baseline. However, most of the administrative costs (all but manifests for shipments of CRTs to smelters and glass processors that do not refurbish CRTs) are assumed to be due to non-CRT hazardous waste and thus are not included in the analysis. The manifest costs that are assumed to be due to CRTs are only for shipments to smelters and glass processors that do not refurbish CRTs and have the same cost as contained in Exhibit 3-7.

3.5.3 Primary Alternative

The full Subtitle C administrative requirements are eliminated under the primary alternative for entities shipping CRTs to collectors, glass processors, and lead smelters. The activities required for these entities are only packaging and labeling requirements for CRTs that are broken. Generators sending CRT waste for disposal are still subject to full RCRA requirements.

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Administrative activities required under the primary alternative and the associated unit costs are summarized in Exhibit 3-8.

3.5.4 CSI Alternative

Subtitle C administrative requirements are significantly reduced under the CSI alternative for entities shipping CRTs to glass processors. The activities required for these handlers are the same types of activities that a facility incurs under the Universal Waste Rule. Generators sending CRT waste to smelters or for disposal are still subject to full RCRA requirements.

Administrative activities required under the CSI alternative and the associated unit costs are summarized in Exhibit 3-9.

Exhibit 3-7: Generator Administrative Requirements and Unit Costs Under the Subtitle C Baseline

Required Activity	Unit Costs	
	SQG	LQG
One-Time Costs*		
Notification of Hazardous Waste Activity	$218	$218
Rule Familiarization	$477	$1,373
Emergency Planning	$533	$787
Total One-Time Costs per Facility	$1,228	$2,378
Annual Costs		
Annual Review of Regulations	$91	$91
Recordkeeping	$47	$47
Personnel Safety Training (annualized cost)	$384	$482
Manifest Training	$37	$180
Biennial Reporting (annualized cost)	$0	$194
Total Annual Costs per Facility	$560	$994
Variable Costs**		
Manifest and Land Disposal Restriction Notification (per shipment)	$44	$54
Exception Reporting (per report)***	$44	$97
Storage Costs (per square foot of storage area)	$8	$8

* Each year one percent of the generators are assumed to be new facilities and thus they incur additional costs as startup facilities. The entry rate is used to determine the number of establishments expected to incur initial costs in any year (one percent of the generator universe).

** Variable costs depend on the number of shipments made by a generator. The number of shipments per year is calculated and used to estimate the administrative costs.

*** The analysis uses an estimate of one half of one percent of manifests require an exception report.

Sources of Cost Data: Supporting Statement for EPA ICR # 261 "Reporting and Recordkeeping Requirements for Generators of Mercury-Containing Lamps" June 29, 1994; Supporting Statement for ICR #801 "Requirements for Generators, Transporters, &

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Waste Management Facilities Under the RCRA Hazardous Waste Manifest System." 2/13/97; Technical Background Document, Economic Impact Analysis for the Proposes Rule for the Management of Spent Mercury-Containing Lamps. 1994; and Supporting Statement for EPA ICR # 0976, Amendment to OMB ICR # 2050-0024 "Analysis of Costs Under Draft Modifications to The Manifest System, Final Report," August 1, 1997.

Exhibit 3-8: Generator Administrative Requirements and Unit Costs Under the Primary Alternative

Required Activity	Unit Costs	
	SQG	LQG
One-Time Costs*		
Rule Familiarization	$477	$477
Total One-Time Costs per Facility	$477	$477
Annual Costs		
Total Annual Costs per Facility	$0	$0
Variable Costs**		
Labeling and Packaging Requirements for Shipments of Broken CRTs	$19	$37
Storage Costs (per square foot of storage area)	$8	$8

* Each year one percent of the generators are assumed to be new facilities and thus they incur additional costs as startup facilities. The entry rate is used to determine the number of establishments expected to incur initial costs in any year (one percent of the generator universe).

** Variable costs depend on the number of shipments made by a generator. The number of shipments per year is calculated and used to estimate the administrative costs.

Sources of Cost Data: Supporting Statement for EPA ICR # 261 "Reporting and Recordkeeping Requirements for Generators of Mercury-Containing Lamps" June 29, 1994; Supporting Statement for ICR #801 "Requirements for Generators, Transporters, & Waste Management Facilities Under the RCRA Hazardous Waste Manifest System." 2/13/97; Technical Background Document, Economic Impact Analysis for the Proposes Rule for the Management of Spent Mercury-Containing Lamps. 1994; and Supporting Statement for EPA ICR # 0976, Amendment to OMB ICR # 2050-0024 "Analysis of Costs Under Draft Modifications to The Manifest System, Final Report," August 1, 1997. Supporting Statement for EPA Information Collection Request Number[] "Reporting and Recordkeeping Requirements for the Proposed Rule on Cathode Ray Tube (CRT) Glass Reuse." Working Draft, October 9, 1998.

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Exhibit 3-9: Handler Administrative Requirements and Unit Costs Under the CSI Alternative

Required Activity	Unit Costs	
	SQH	LQH
One-Time Costs*		
Notification of Hazardous Waste Activity	$0	$185
Rule Familiarization	$477	$477
Total One-Time Costs per Facility	$477	$662
Annual Costs		
Annual Review of Regulations	$47	$47
Mark CRT Materials or Storage Area	$27	$53
Mark Time/Date on CRT Material	$27	$53
Total Annual Costs per Facility	$100	$154
Variable Costs**		
Recordkeeping of Outbound Shipments (per shipment)	$0	$4

* Each year one percent of the handlers are assumed to be new facilities and thus they incur additional costs as startup facilities. The entry rate is used to determine the number of establishments expected to incur initial costs in any year (one percent of the handler universe).

** Variable costs depend on the number of shipments made by a handler. The number of shipments per year is calculated and used to estimate the administrative costs.

Source of Cost Data: Supporting Statement for EPA Information Collection Request "Reporting and Recordkeeping Requirements for the Proposed Rule on Cathode Ray Tube (CRT) Glass Reuse," October 1998.

3.6 Estimate Disposal Costs

The CRT management options currently being used by CRT generators include giving CRTs to establishments that will reuse them, and sending CRTs to collectors, glass processors, smelters, or treatment and disposal facilities that dispose of the treated CRTs in Subtitle C or D landfills. The per ton cost for each disposal option is based on a literature search and on contacts at representative facilities. The disposal costs obtained for each disposal option varied considerably. The maximum cost typically is two to four times the minimum cost obtained for each disposal option. For each disposal option the average of the costs obtained is used in the analysis. Exhibit 3-10 summarizes the cost per ton for each disposal option.

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Exhibit 3-10: CRT Disposal Costs (per ton)

Disposal Option	Cost (Price Paid) per Ton
Collectors	$ 271
Export	$ 107
Reuse	$ 0
Treatment and Subtitle C or D Landfill Disposal	
Whole CRTs	$ 1,500
Crushed CRTs	$ 160
Reclaimer	
Whole CRTs	$ 295
Whole bare CRTs	$ 207
Crushed CRTs	$ 152
Glass Processor	
Broken CRTs with no metal	$ 0
Broken CRTs with metal	$ 100
Whole bare CRTs	$ 192
Broken mixed color and monochrome CRTs	$ 325
Whole CRTs	$ 333
CRT Glass Manufacturer	($ 175)

Details of the disposal costs by source are presented in Appendix C.

3.7 Estimate Transportation Costs

Under the baseline and each alternative, either hazardous or non-hazardous waste transportation costs are used depending on the status of the CRTs being shipped. Different costs are also used for shipments that are assumed to be partial truckloads and full truckloads. Shipments of CRTs from collectors and glass processors are assumed to be full truckloads, except for collector shipments sending CRTs for reuse. Shipment of CRTs for reuse are assumed to be partial truckloads for three reasons:

- the collectors get the highest benefit from returning the CRTs to the market place as quickly as possible, and thus are less likely to wait until they have a full truckload.

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- the shipping distances for reuse are likely to be relatively short, because most CRTs are reused locally, thus the expense of sending partial loads is roughly equivalent to sending full shipments.

- collectors who primarily refurbish CRTs for reuse tend to be smaller and handle smaller volumes and thus may take a long time to generate a full truckload of CRTs for reuse.

Exhibit 3-12 provides a summary of the two factors (i.e., hazardous or non-hazardous transport and partial or full truckload) that drive the transportation costs for each of the disposal options. The analysis assumes that shipments of less than one truckload are consolidated by the shipping company prior to trucking the waste CRTs to a disposal facility, and that consolidated rates are passed on to generators. The analysis assumes consolidated shipments because of the low volumes of waste (0.5 to 6 tons for original users and 9 to 16 tons for collectors under the baseline) and because generators are clustered around urban and suburban areas. As discussed in Section 3.4, regulated generators are found in 66 different two-digit SIC codes. For any individual generator the assumption made in this analysis will not be accurate. However, in the aggregate the assumptions used in the analysis reasonably estimate the actual transportation costs incurred.

Exhibit 3-12: Transportation Cost Driver Assumptions

	CRT Management Options					
	Collectors	Reuse	Treatment & Disposal	Reclaimer	Glass Processor	CRT Glass Manufacturer
Baseline						
Original Users	NH - LTT	NH - LTT	H - LTT	H - LTT	NH - LTT	NA
Collectors	NA	NH - LTT	H - TL	H - TL	H - TL	NA
Glass Processors	NA	NA	NA	H - TL	NA	H - TL
Primary Alternative						
Original Users	NH - LTT	NH - LTT	H - LTT	NH - LTT	NH - LTT	NA
Collectors	NA	NH - LTT	H - TL	NH - TL	NH - TL	NA
Glass Processors	NA	NA	NA	NH - TL	NA	NH - TL
CSI Alternative						
Original Users	NH - LTT	NH - LTT	H - LTT	H - LTT	NH - LTT	NA
Collectors	NA	NH - LTT	H - TL	H - TL	NH - TL	NA
Glass Processors	NA	NA	NA	H - TL	NA	NH - TL

NH = Non-hazardous transport.
H = Hazardous material transport.
LTT = Less than truck load shipments.
TL = Full truck load shipments.

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NA = Not applicable.

The transportation costs for less than truck load shipments consist of two parts, a fixed fee and a variable fee based on tons shipped and miles driven. The variable portion of the per shipment transportation cost is based on an average shipment size and the assumed miles that the CRTs are shipped to each disposal option. For SQGs the average shipment size is calculated by dividing the total tons of CRTs shipped by the total number of shipments. The total number of shipments is calculated by assuming that each SQG ships twice a year and multiplying by the number of SQGs. The same methodology is used for calculating the average shipment size for LQGs, except LQGs ship CRTs four times per year. Under the regulatory alternatives, unregulated establishments are assumed to ship CRTs once per year, unless they generate enough CRTs to need two shipments. Only formerly regulated collectors generate enough CRTs to need two shipments per year. Glass processors are estimated to make 23 shipments of funnel glass under the baseline, 32 shipments under the primary alternative, and 34 shipments under the CSI alternative. The glass processor shipments only include shipments of funnel glass, because panel glass does not contain enough lead to render it hazardous waste when discarded. The transportation costs for full truck load shipments consists of a variable fee based on the miles the load must be shipped. Appendix E contains the average shipment sizes for each type of entity distributing CRTs to each of the management options. Exhibit 3-13 presents the cost functions for hazardous waste and non-hazardous materials for both less than truckload and full truck loads. These cost functions include the pre-shipment handling and administrative costs associated with each shipment. Exhibit 3-14 presents the estimated or assumed mileage between each type of establishment distributing CRTs and the CRT management options.

The transportation costs to collectors and disposal facilities for generators due to non-CRT hazardous waste are zero because the CRTs are assumed to be shipped with the generator's other hazardous waste. The actual cost is greater than zero but is not significant to the analysis.[23]

[23] The cost to transport CRTs for generators due to non-CRT waste is estimated to be less than $20 per shipment. This estimate is based on the per ton-mile rate of $0.16, 250 miles to a treatment and disposal facility, and 0.5 tons of CRTs per shipment. The actual tons shipped by these generators is typically less than 0.5 tons. There are approximately 800 establishments in this category. Thus the total shipping cost is approximately $16,000, or less than one half of one percent of the savings under the primary alternative.

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Exhibit 3-13: Transportation Cost Functions

	< 50 miles		50 to 400 miles	
	Hazardous	Non-Hazardous	Hazardous	Non-Hazardous
Full Truck Loads	NA	$3.41/mile	$2.98/mile	$2.25/mile
Less Than Truck Load	NA	$108 + $0.18/ton-mile	$162 + $0.16/ton-mile	$108 + $0.12/ton-mile

Source: ICF Memorandum to Allen Maples, EPA, August 31, 1998.
NA = Not applicable.

Exhibit 3-14: Transportation Distances for Each CRT Management Option (Miles)

	CRT Management Options					
	Collectors	Reuse	Treatment & Disposal	Reclaimer	Glass Processor	CRT Glass Manufacturer
Original Users	20	20	250	300	200	NA
Collectors	NA	20	250	300	200	NA
Glass Processors	NA	NA	NA	350	NA	100

NA = Not applicable.

3.8 Estimate Storage Costs

Storage costs may increase for former generators under the regulatory alternatives because the frequency of shipments decreases relative to shipments by generators. This section contains the storage costs applicable to generators and former generators.

Storage costs depend on several assumptions about the type of storage facility that is used by the generator. Some generators may use offsite commercial warehouse space which generally cost three to four dollars per square foot for an annual rental, plus handling fees for each shipment in or out of the warehouse.[24] Other generators may store materials in self storage facilities that generally cost $12 to $15 per square foot per year.[25] Finally other generators may have on site storage that they use. The on site storage cost can be considered to be zero if space is available and the building space is considered a sunk cost. However, for some generators there will be an opportunity cost of storing the

[24] Conversation with Hagerstown Transload Services on February 9, 1999.

[25] Conversation with American Moving and Storage on February 9, 1999.

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CRTs. In this case the storage cost is the cost of the lease or rent per square foot. The analysis assumes an average cost of eight dollars per square foot per year for storage.[26]

The model assumes that each CRT will occupy three cubic feet and that the CRTs will be stacked up to eight feet high. Exhibit 3-15 summarizes the number of CRTs stored and the annual storage costs for each type of generator.

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[26] The storage cost of eight dollars per square foot is an assumed average cost based on the information from the two storage companies contacted, Hagerstown Transload Services and American Moving and Storage.

Exhibit 3-15: Storage Costs for Monitors

	Number of CRTs Stored	Storage Area Required (ft^2)	Cost per Square Foot	Annual Storage Cost
Generators Due to CRTs Alone				
Baseline				
SQG	84	31	$8.30	$261
LQG	319	119	$8.30	$991
Primary Alternative				
SQG	84	31	$8.30	$261
LQG	319	119	$8.30	$991
Former SQG	168	63	$8.30	$522
Former LQG	637	239	$8.30	$1,983
CSI Alternative				
SQG	84	31	$8.30	$261
LQG	319	119	$8.30	$991
SQH	170	64	$8.30	$529
LQH	NA	NA	NA	NA
Generators Due to CRTs and Non-CRT Hazardous Waste				
Baseline				
SQG	25	9	$8.30	$78
LQG	13	5	$8.30	$40
Primary Alternative				
SQG	25	9	$8.30	$78
LQG	13	5	$8.30	$40
Former SQG	50	19	$8.30	$154
Former LQG	51	19	$8.30	$159
CSI Alternative				
SQG	25	9	$8.30	$78
LQG	13	5	$8.30	$40
SQH	NA	NA	NA	NA
LQH	NA	NA	NA	NA

NA = Not Applicable

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3.9 Estimate Costs for Glass Processors and Transporters

3.9.1 Costs to Glass Processors

Only a small number of dedicated processors exists at present. The analysis estimates there are five glass processors. The glass reclamation process is exempt from RCRA Subtitle C regulation (40 CFR 261.6(c)(1)). However, under the baseline the storage of CRTs prior to reclamation requires a RCRA Part B Permit. The estimated cost for obtaining a storage permit is $13,300.[27] If a glass processor refurbishes some of the CRTs, then any CRTs sent to the glass processor that possibly will be refurbished are not a solid waste. Exhibit 3-16 shows the glass processor activities required under the baseline and regulatory alternatives and the associated unit costs.

3.9.2 Costs to CRT Glass Transporters

Current CRT transporters are assumed to transport other hazardous wastes and other non-hazardous materials and, consequently, do not incur savings under the proposed rule. To the extent that new transporters enter the CRT market that do not transport other hazardous wastes, these new transporters will incur minor compliance costs attributable to reviewing regulations. The analysis does not attempt to quantify the costs associated with new transporters shipping CRTs due to the uncertainty in the number of new transporters likely to enter this market and the estimated small impact on the overall analytical results.

[27] ICF Incorporated, *Economic Impact Analysis for the Military Munitions Final Rule*, June 1996.

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Exhibit 3-16: Glass Processor Compliance Requirements and Unit Costs

Required Activity	Unit Costs		
	Baseline	Primary Alternative	CSI Alternative
Initial Fixed Costs			
Notification of Hazardous Waste Activity	$218	$218	$218
Rule Familiarization	$1,373	$1,373	$1,373
Emergency Planning	$787	$787	$787
Environmental Justice Requirements	$0	$0	$159
Total Initial Fixed Costs per Facility	$2,378	$2,378	$2,537
Annual Costs			
Annual Review of Regulations	$91	$91	$91
Recordkeeping	$47	$47	$47
Personnel Safety Training (annualized cost)	$482	$482	$482
Manifest Training	$180	$180	$180
Biennial Reporting	$194	$194	$194
Total Annual Costs per Facility	$994	$994	$994
Variable Costs			
Manifest and Land Disposal Restriction Notification (per shipment)	$54	$0	$0
Recordkeeping of Incoming Shipments (per shipment)	$0	$0	$4
Recordkeeping of Outbound Shipments (per shipment)	$0	$0	$9

Source of Cost Data: Supporting Statement for EPA Information Collection Request Number [ ] "Reporting and Recordkeeping Requirements for the Proposed Rule on Cathode Ray Tube (CRT) Glass Reuse," October 1998; and Supporting Statement for EPA ICR # 261 "Reporting and Recordkeeping Requirements for Generators of Mercury-Containing Lamps" June 29, 1994.

3.10 Estimate the Impact of Compliance Costs on Affected Entities

The analysis estimates first-order economic impacts of incremental costs by calculating the cost-to-sales ratio for each type of original user in each two-digit SIC code. Census data for the year 1994 served as the source of average sales data for establishments in each two-digit SIC code. (Appendix F presents the average sales per establishment for all SIC codes used in the calculations for this report.) Incremental compliance costs or cost savings for representative establishments are developed by adding the costs as described previously. For purposes of this analysis, economic impacts are considered significant if costs exceed three percent of sales.

The impacts analysis is likely to overstate economic impacts (whether costs or savings) because the sales data used in the analysis represent average values for each SIC code as a whole, whereas the estimated compliance costs arise only for the entities that are large enough to be considered an SQG or

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LQG in the baseline. Such entities are likely to have an average sales value higher than the average for the industry as a whole.

3.11 Methodology for Subtitle D Management Baseline

This analysis includes a Subtitle D management baseline because it may more accurately represent current CRT management practices. This baseline uses the same methodology and assumptions as the RCRA Subtitle C baseline except for three changes in assumptions. The first change is the percentage of facilities assumed to manage CRTs using Subtitle D landfills. The second change is the assumed flow of CRTs to each of the disposal options, including Subtitle D landfills. The third change is that estimated costs are different under this baseline. One similarity between the baselines is the percent of CRTs recycled. Although the number of tons of CRTs sent for recycling under the two baselines differs by about a factor of five, the percent of CRTs sent for recycling is approximately the same at about 45 percent.

The Subtitle D management baseline assumes that 20 percent of facilities are managing their CRTs as Subtitle C waste and 80 percent of facilities are managing their CRTs as Subtitle D waste. The 20 percent of facilities that are managing their CRTs under Subtitle C incur all of the administrative, disposal, transportation, and storage costs as discussed in Sections 3.5 through 3.8. Under these assumptions in the baseline, there are 213 SQGs, 23 LQGs, and 2,648 establishments sending CRTs to Subtitle D landfills without treatment. The primary alternative is assumed to induce some establishments sending CRTs to Subtitle D landfills to send their CRTs to glass processors or reclaimers. Thus under the primary alternative, there are 58 SQGs, 5 LQGs, 155 former SQGs, 18 former LQGs, and 2,648 establishments sending CRTs to Subtitle D landfills. The CSI alternative is assumed to induce some establishments sending CRTs to Subtitle D landfills to send their CRTs to glass processors. Thus under the CSI alternative, there are 32 SQGs, 4 LQGs, 200 small quantity handlers (CSI SQHs), and 2,648 establishments sending CRTs to Subtitle D landfills. Exhibit 3-17 contains the flow assumptions for CRTs under the Subtitle D management baseline. Exhibits 3-18 and 3-19 contain the flow assumption for CRTs under the primary and CSI alternatives, respectively.

The cost for managing CRTs under the Subtitle D baseline are assumed to include only disposal costs of $41 per ton. Thus, facilities managing CRTs under the Subtitle D baseline have no administrative costs, no storage costs, and no transportation costs. There are no administrative costs because these facilities will not prepare manifests, review regulations on an annual basis, or conduct any of the other activities required under Subtitle C management. The storage costs are assumed to be zero because facilities will not store the CRTs, but will place them with their other trash as soon as they discard the CRTs. The transportation costs are approximately zero because facilities will place the CRTs in with their other trash and not ship the CRTs separately. An incremental transportation cost could be attributed to the CRTs based on the weight of the CRTs and the hauling charges companies pay for their trash; however, the analysis assumes that any incremental transportation cost is immaterial to the results.

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Exhibit 3-17: Assumed Distribution of Discarded Monitors and CRT Glass Under the Subtitle D Management Baseline

Entity Distributing CRTs	Reuse	Export	Intermediate Processors		Disposal Options				Total Percent	Total Tons Disposed
			Collector	Glass Processor	Municipal Solid Waste Landfill	Hazardous Waste Facility	Reclaimer	CRT Glass Manufacturer		
Disposal Cost	$0/ton (I)	$100/ton (I)	$271/ton (I)	$333/ton (I) $0/ton (C)	$41/ton	$1,500/ton (I) $160/ton (C)	$207/ton (I) $152/ton (C)	- $175/ton (C)		
Original User SQGs and LQGs*										
Due to CRTs Only	2% (I)	0%	6% (I)	5% (I)	80% (I)	2% (I)	5% (I)	NA	100%	43,577
Due to CRTs and Non-CRT Hazardous Waste	0% (I)	0%	10% (I)	0%	80% (I)	10% (I)	0%	NA	100%	2,647
Collectors										
SQGs	20% (I)	20% (I)	NA	5% (I)	50% (B)	0% (B)	5% (B)	NA	100%	240
LQGs	20% (I)	20% (I)	NA	10% (C)	43% (B)	2% (C)	5% (C)	NA	100%	2,639
Glass Processors	0%	0%	NA	NA	0%	0%	2% (C)	98% (C)	100%	1,473
Total Tons	1,447	576	2,879	1,473	38,234	1,168	2,295	1,443		

* Disposal costs shown are representative simplifications of the actual costs used in the analysis. See 3-10 for further details.
(I) = Intact whole monitors.
(B) = Bare CRTs without the casing.
(C) = Crushed CRT glass.
NA = Not Applicable.

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Exhibit 3-18: Assumed Distribution of Discarded Monitors Under the Primary Alternative and the Subtitle D Baseline

Entity Distributing CRTs	Reuse	Export	Intermediate Processors		Disposal Options				Total Percent	Total Tons Disposed
			Collector	Glass Processor	Municipal Solid Waste Landfill	Hazardous Waste Facility	Reclaimer	CRT Glass Manufacturer		
Disposal Cost*	$0/ton (I)	$100/ton (I)	$271/ton (I)	$333/ton (I) $0/ton (C)	$41/ton	$1,500/ton (I) $160/ton (C)	$207/ton (I) $152/ton (C)	- $175/ton (C)		
Original Users										
SQGs and LQGs	NA	NA	NA	NA	NA	2% (I)	NA	NA	100%	46,224
Former SQGs and LQGs	2% (I)	0%	10% (I)	6% (I)	NA	NA	7% (I)	NA		
Out of Compliance SQGs and LQGs	NA	NA	NA	NA	75% (I)	NA	NA	NA		
Collectors										
Regulated Post-Rule										
SQGs	20% (I)	30% (I)	NA	10% (B)	40% (B)	2% (B)	13% (B)	NA	100%	8
LQGs	20% (I)	18% (I)	NA	15% (C)	40% (B)	2% (C)	8% (C)	NA	100%	83
Unregulated Post-Rule										
Former SQGs	20% (I)	15% (I)	NA	10% (B)	40% (B)	NA	15% (B)	NA	100%	370
Former LQGs	20% (I)	15% (I)	NA	15% (C)	40% (B)	NA	10% (C)	NA	100%	4,070
Glass Processors	0%	0%	NA	NA	0%	0%	2% (C)	98% (C)	100%	2,027
Total Tons	1,812	680	4,530	2,027	35,788	923	3,494	1,987		

* Disposal costs shown are representative simplifications of the actual costs used in the analysis. See 3-10 for further details.
(I) = Intact whole monitors.
(B) = Bare CRTs without the casing.
(C) = Crushed CRT glass.
NA = Not Applicable.

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Exhibit 3-19: Assumed Distribution of Discarded Monitors Under the CSI Alternative and the Subtitle D Baseline

Entity Distributing CRTs	Reuse	Export	Intermediate Processors		Disposal Options				Total Percent	Total Tons Disposed
			Collector	Glass Processor	Municipal Solid Waste Landfill	Hazardous Waste Facility	Reclaimer	CRT Glass Manufacturer		
Disposal Cost*	$0/ton (I)	$100/ton (I)	$271/ton (I)	$333/ton (I) $0/ton (C)	$41/ton	$1,500/ton (I) $160/ton (C)	$207/ton (I) $152/ton (C)	- $175/ton (C)		
Original Users										
SQGs and LQGs	NA	NA	NA	NA	60% (I)	15% (I)	25% (I)	NA	100%	6,926
Former SQGs and LQGs (SQHs and LQHs)	2% (I)	0% (I)	10% (I)	10% (I)	NA	NA	NA	NA	22%	8,646
Out of Compliance SQGs and LQGs	NA	NA	NA	NA	78%	NA	NA	NA	78%	30,652
Collectors										
SQGs	20% (I)	20% (I)	NA	10% (B)	38% (B)	2% (B)	10% (B)	NA	100%	327
LQGs	20% (I)	20% (I)	NA	15% (C)	38% (B)	2% (C)	5% (C)	NA	100%	3,602
Glass Processors	0%	0%	NA	NA	0%	0%	2% (C)	98% (C)	100%	2,702
Total Tons	1,572	786	3,930	2,702	36,301	1,086	1,913	2,648		

* Disposal costs shown are representative simplifications of the actual costs used in the analysis. See Exhibit 3-10 for further details.
(I) = Intact whole monitors.
(B) = Bare CRTs without the casing.
(C) = Crushed CRT glass.
NA = Not Applicable.

3.12 Limitations of the Methodology and Data

The accuracy of the analysis depends on a wide variety of data and assumptions. The following is a list of assumptions, limitations, and other factors affecting the accuracy of the analysis. Some assumptions tend to increase or decrease the savings of the alternatives, as noted in the discussion of the individual assumptions. Except where noted, assumptions are best estimates and are not believed to introduce systematic bias into the results.

3.12.1 Assumptions

Life Cycle Flow of CRTs

- *The assumed percentages of CRTs sent from generators to Subtitle C or D landfills, smelters, glass processors, collectors, and for reuse or export.* Information on the flow of CRTs is mostly anecdotal. See Exhibits 3-3, 3-4, 3-5, 3-17, 3-18, and 3-19 for the percentages used in the analysis. In developing the flow percentages, the analysis takes into consideration the stigma of hazardous waste.

- *The assumed percentage of generators that are no longer regulated under the primary or CSI alternatives*. Under the primary alternative 98 percent of baseline generators are assumed to no longer be regulated. Under the CSI alternative 85 percent of generators, who are original users, are assumed to no longer be regulated. More generators become unregulated under the primary alternative because CRTs going to reclaimers are not regulated.

- *The number of CRTs from televisions discarded by businesses is insignificant compared to the number of CRTs from monitors.* Available data on television use in businesses are not adequate to incorporate into the analysis. The number of televisions used in businesses is believed to be relatively insignificant compared with the number of computer monitors.[28] Eliminating televisions from the analysis is not believed to significantly affect the analysis, although this assumption could change if business use of televisions increases (e.g., due to increases in televideo conferencing). This assumption may result in the reported savings of the alternatives being understated because the total number of CRTs generated is underestimated.

- *Original users do not export CRTs directly. Only collectors export CRTs.*

- *All exports of CRTs are of intact CRTs for refurbishment and reuse.*

[28] One of the most likely industries to discard a significant quantity of televisions is the hotel industry, which is exempt from the RCRA hazardous waste requirements (40 CFR §261.4(b)(1)).

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Monitor Characteristics

- *The lifetime of a computer monitor in businesses is assumed to be 3.5 years.*

- *The estimated percentage of color monitors in use in businesses 3.5 years prior to the modeled year is 90 percent.*

- *The assumed percentage of laptop computers in use 3.5 years prior to the modeled year is 18 percent.*

- *The estimated average weight of computer monitors being discarded in the modeled year is 35 pounds.*

Transportation

- *The assumed transportation costs for hazardous waste generators that are generators due to non-CRT hazardous wastes.* These generators are assumed to include their CRTs in regular shipments of other hazardous waste when the CRTs are sent for treatment and disposal in Subtitle C or D landfills. Thus the cost of shipping the CRTs to these disposal options is only an incremental cost and is assumed to be zero in the analysis for both the baseline and regulatory alternatives. When these generators send CRTs to collectors, smelters, or glass processors the analysis assumes that these are dedicated shipments and the generator incurs transportation costs under both the baseline and regulatory alternatives. This assumption may result in the reported savings of the alternatives being underestimated because the costs of shipping CRTs is underestimated.

- *Under the baseline, shipments of CRTs are transported as hazardous waste if the shipments are going for disposal, to lead smelters, or to glass processors. Under the primary alternative, shipments of CRTs are transported as hazardous waste only if the shipments are going for disposal. Under the CSI alternative, shipments of CRTs are transported as hazardous waste if the shipments are going for disposal or to lead smelters.*

- *The distances to each of the CRT management options.* See Exhibit 3-14 for the transportation distances used in the analysis.

Generators

- *The assumed distribution of SQGs across all two-digit SIC codes.* Existing databases do not track the SIC codes of all SQG generators. The analysis assumes that the distribution of SQGs across SIC codes is the same as it is for SQGs that are

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reported in the Resource Conservation and Recovery Information System (RCRIS) database.

- *The assumed distribution of SQGs and LQGs across establishment size ranges within a two-digit SIC code.* The analysis assumes that SQGs are 1.5 times and LQGs are 2 times more likely to have 250 or more employees than non-generator establishments. This is based on the presumption that larger facilities with more employees are more likely to meet the thresholds for establishments becoming SQGs or LQGs.

- *The assumed cost savings for generators that are generators due solely to the disposal of CRTs.* The analysis assumes that establishments qualifying as generators solely due to CRTs do not generate any other hazardous waste and thus can achieve the maximum savings possible under the proposed rule. This assumption results in the reported savings of the alternatives being overstated because the total number of these generators is likely to be overestimated.

- *Under the CSI alternative, all collectors will send some CRTs for disposal or to lead smelters.* Therefore, all collectors continue to be fully regulated under the CSI alternative. This assumption results in the reported savings of the CSI alternative being understated because it is unlikely that all collectors will continue to send some CRTs for disposal or to a lead smelter.

- *Original users only send intact CRTs.* This assumption results in the reported savings of the alternatives being overstated because some administrative costs are avoided by generators in the analysis.

- *Collectors who are SQGs send bare CRTs that have had the casing and electronics removed.*

- *Collectors who are LQGs are the only entities sending any broken CRTs to reclaimers, hazardous waste facilities, and glass processors.* This assumption results in the reported savings of the alternatives being overstated because some administrative costs are avoided by SQGs in the analysis.

- *One half of all collectors are assumed to send CRTs for disposal or reclamation and thus are regulated under the baseline.* The other half of the collectors are assumed to send CRTs for reuse, export, or to glass processors who refurbish CRTs.

- *The number of CRTs that glass processors send for reuse is insignificant compared to the number of CRTs that are processed for new CRT glass.* This assumption results in the reported savings of the alternatives being understated because potential savings are not captured.

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- *Seventeen percent of collectors are assumed to be SQGs.* Collectors who are SQGs are assumed to be primarily refurbishers who are able to resell most CRTs with only small volumes that they discard. Collectors who are LQGs are assumed to be primarily recyclers who need to recycle large volumes of CRTs to make their business profitable.

- *Eight percent of all CRTs are received by collectors who are SQGs.*

- *The analysis models the flow of all CRTs discarded by original users in amounts exceeding the threshold for conditionally exempt small quantity generators (more than 100 kg per month), even though many of these original users are not regulated (because they send their CRTs to collectors, for reuse, or to glass processors that refurbish CRTs), and do not accrue incremental costs.* The flow of CRTs from these entities is modeled in order to calculate incremental costs on other regulated entities (e.g., collectors).

Disposal Options

- *The assumed available capacity of U.S. lead smelters to take discarded CRTs.* The analysis assumes that all U.S. lead smelters are available to accept discarded CRTs, storing them as necessary. The actual availability of smelters might be less, because CRTs are shipped as a hazardous waste and smelters who store CRTs must obtain a RCRA Part B permit. The resources needed and potential compliance consequences of obtaining a Part B permit discourage most if not all smelters from obtaining the permit, thus disqualifying them for storing CRTs.

- *The analysis assumes that lead smelters do not refurbish CRTs for reuse.* Thus under the baseline all shipments of CRTs to lead smelters are regulated shipments. This assumption results in the reported savings of the alternatives being overstated because it tends to increase the difference between the baseline and alternatives.

Storage

- *The analysis assumes a single storage cost rate ($8/ft^2) for all facilities, regardless of potentially available storage alternatives.*

- *Collectors and processors are not allocated storage costs.* These entities are not allocated storage costs because their storage of CRTs is not driven by the regulations and is an integral part of their primary business.

3.12.2 Limitations

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- *State and local governments and their discarded CRTs are not included in the model.* This assumption results in the reported savings of the alternatives being understated because the total number of generators is underestimated.

- *The analysis does not model CRTs coming out of or going into long-term storage.* Long-term storage is defined as more than one year.

- *The impacts analysis is likely to overstate economic impacts (whether costs or savings) because the sales data used in the analysis represent average values for each SIC code as a whole, whereas the estimated compliance costs arise only for the entities that are large enough to be considered an SQG or LQG in the baseline.* Such entities are likely to have an average sales value higher than the average for the industry as a whole.

3.12.3 Other Factors

- Consistent with least-cost behavior, the analysis reflects generators of non-CRT hazardous wastes only to the extent that these entities generate 30 or more CRTs per year. Generators discarding less than 30 CRTs per year are assumed in the baseline to consolidate their CRTs shipments with shipments of other hazardous waste; in this case, the transportation cost for shipping the CRTs is only an incremental cost (i.e., relative to the cost of shipping the other hazardous wastes). The incremental cost for shipping less than 30 CRTs is less than $18 per shipment. Under the two regulatory alternatives, if these generators were to ship CRTs to glass processors or reclaimers, they would be assumed to ship the CRTs on a separate truck, thereby incurring a significant increase in transportation costs of more than $100 per shipment. Given the increase in transportation cost and the low volume of CRTs (i.e., less than 30), the least cost behavior for these hazardous waste generators is to continue consolidating CRTs with other hazardous waste shipments. The model does not include such generators whose behavior will not be affected by the alternatives. The sensitivity analysis in Sections 4.2.4, 4.3.4, 5.2.4, and 5.3.4 includes the CRTs from these entities as well as from CESQGs.

- The amount of CRT glass that CRT glass manufacturers can recycle is a potentially limiting factor in the amount of CRTs that can be economically recycled. A recent study estimates that CRT glass manufacturers could use 125,100 tons of post-consumer cullet using the current sorting technology.[29] If better sorting technology is developed, then the amount the CRT glass manufacturers could use will increase to at

[29] Monchamp, A., Evans, H., Nardone, J., Wood, S., Proch, E., and Wagner, T., Cathode Ray Tube Manufacturing and Recycling: Analysis of Industry Survey. Electronics Industries Alliance, May 2001.

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least 161,600 tons per year. The model estimates that 12 million color CRT monitors enter the waste stream each year from all businesses (regulated and unregulated). At an average weight of 35 pounds per CRT, the total weight of color CRT monitors entering the waste stream is 210,000 tons. The CRT glass constitutes approximately 60 percent of the CRT weight; so the total amount of CRT glass entering the waste stream per year from businesses is 126,000 tons.[30] Thus, all post consumer CRT glass that is estimated to be generated by all businesses, not just those entities considered in this analysis, could be used by CRT glass manufacturers. The amount of CRT glass currently entering the waste stream from regulated establishments is estimated at below 44,000 tons. Therefore, it does not appear that the amount of glass that CRT glass manufacturers can accept should be a limiting factor in CRT glass-to-glass recycling.

- The production capacity of glass processors is a potentially limiting factor in the amount of discarded CRTs that can be recycled each year, and thus is a limiting factor for the success of the proposed rule. Currently there are only a few glass processors. The largest processor is Envirocycle, with an estimated production capacity of 45,000 tons of CRTs per year.[31] However, the estimated total amount of CRTs generated by regulated generators is 43,750 tons per year. Envirocycle obtains about 10,000 tons of CRTs from computer monitor and television manufacturers.[32] Thus, Envirocycle seems unlikely to have enough current capacity to process all CRTs generated by regulated entities. Envirocycle plans to open two new processing facilities by the end of 2001 that will add additional capacity. Also, the capacity of the second glass processor is likely to be greater than 8,750 tons per year. Therefore, the production capacity of glass processors is not likely to be an active constraint on the number of regulated CRTs that could be recycled each year.

- The real-world conditions that are approximated in the analysis are likely to change significantly over the next several years. For example, both the number of computers used in businesses and the percent of color monitors in use are expected to increase over time, which would increase the savings under the proposed rule. On the other hand, trends towards greater use of laptop computers and other flat screen monitors may eventually lead to reduced savings.

- The analysis does not take into consideration State and local laws that prohibit CRTs from being disposed in municipal solid waste landfills and incinerators or the inclusion of

[30] The Microelectronics and Computer Technology Corporation (MCC), page 231.

[31] ICF communication with Greg Voorhees of Envirocycle, 2001.

[32] ICF communication with Greg Voorhees of Envirocycle, 1996 and 2001, and Envirocycle web page.

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CRTs in various State's Part 273 regulations. By not considering such information, the analysis tends to overestimate the savings accruing to each regulatory alternative.

4.0 Cost Results and Sensitivity Analysis for Subtitle C Management Baseline

The incremental annual savings attributable to both the primary alternative and the CSI alternative are calculated by subtracting the estimated costs under each alternative from the estimated costs under the Subtitle C baseline.

4.1 Costs Under the Subtitle C Baseline

The total applicable cost of compliance in the Subtitle C baseline is calculated for several groups of affected entities. As shown in Exhibit 4-1, the analysis categorizes affected entities based on whether they are original users or collectors, the amount of waste they generate (SQGs or LQGs), and, for original users, whether they are regulated solely because of CRT generation or because of a combination of CRT and non-CRT hazardous waste generation. Collectors are all assumed to be regulated solely because of CRT generation. Compliance costs also are calculated for glass processors. Exhibit 4-1 presents the cost per establishment for administrative, storage, transportation, and disposal costs, and for the total cost of compliance under the baseline. Administrative costs are assumed to be the same for all generators in each size category (small or large). The other costs vary across the categories (based on RCRA requirements for different types of generators, on the average number of CRTs discarded, and on the disposal method used by that generator). So Exhibit 4-1 presents the average cost for each group of generators.

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Exhibit 4-1: Subtitle C Baseline Compliance Costs

	Average Costs per Generator				Number of Regulated Generators	Average Costs per Potentially Regulated Generator		Number of Potentially Regulated Generators	Total Cost
	Admin.	Storage	Transp.	Disposal		Transp.	Disposal		
Original Users (Generating No Non-CRT Hazardous Waste)									
SQG	$ 660	$ 261	$ 270	$ 870	2,066	$ 270	$ 870	10,085	$ 15,763,000
LQG	$ 1,234	$ 991	$ 739	$ 6,616	61	$ 739	$ 6,616	295	$ 2,754,000
Subtotal									$ 18,517,000
Original Users Also Generating Non-CRT Hazardous Waste									
SQG	$ 88	$ 78	$ 255	$ 501	534	$ 255	$ 501	1,602	$ 1,703,000
LQG	$ 217	$ 40	$ 499	$ 517	223	$ 499	$ 517	668	$ 962,000
Subtotal									$ 2,665,000
Collectors									
SQG	$ 668	$ 0	$ 828	$ 3,370	50	$ 828	$ 3,370	50	$ 453,000
LQG	$ 1,232	$ 0	$ 1,554	$ 3,989	250	$ 1,554	$ 3,989	250	$ 3,080,000
Subtotal									$ 3,533,000
Glass Processors									
	$ 2,316	$ 0	$ 6,754	$ (83,960)	5	N/A	N/A	N/A	$ (374,000)
Total Baseline Compliance Costs									$ 24,342,000

Note: Total cost numbers rounded to nearest thousand. Costs may not add due to rounding.

4.2 Primary Alternative

4.2.1 Costs Under the Primary Alternative

The total applicable cost of compliance under the primary alternative is calculated for all of the generators described in Section 4.1, and for all of the entities that were formerly generators but that no longer are required to comply with the hazardous waste regulations. These are called "former generators." Exhibit 4-2 presents the cost per establishment for administrative, storage, transportation, and disposal costs, and for the total cost of compliance under the primary alternative. Administrative costs are assumed to be the same for all generators in each size category (small or large). The other costs vary across the categories (based on RCRA requirements for different types of generators, on the average number of CRTs discarded, and on the CRT management method used by that generator). So Exhibit 4-2 presents the average cost for each group of generators.

The average transportation and disposal cost for SQGs and LQGs changes between the baseline and the primary alternative because, in the baseline, five CRT management options (collector, reuse, processor, smelter, and hazardous waste landfill) are available while in the primary alternative only one disposal option (hazardous waste landfill) is considered for regulated generators and four of

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the CRT management options are available (collector, reuse, processor, and smelter) for "former" generators. The reason for the changes in average collector costs is similar. Under the baseline, five CRT management options are available (reuse, processor, smelter, hazardous waste landfill, and export). Under the primary alternative, the same five CRT management options are averaged for regulated collectors, while "former" collectors have only four CRT management options (reuse, processor, smelter, and export).

Exhibit 4-2: Primary Alternative Compliance Costs Under the Subtitle C Baseline

	Average Costs per Generator				Number of Regulated Generators	Average Costs per Potentially Regulated Generator		Number of Potentially Regulated Generators	Total Cost
	Admin.	Storage	Transp.	Disposal		Transp.	Disposal		
Original Users (Generating No Non-CRT Hazardous Waste)									
Former SQG	$ 0	$ 522	$ 136	$ 798	1,823	$ 136	$ 798	10,085	$ 12,078,000
Former LQG	$ 0	$ 1,983	$ 428	$ 6,068	54	$ 428	$ 6,068	295	$ 2,374,000
Subtotal									$ 14,452,000
Original Users Also Generating Non-CRT Hazardous Waste									
Former SQG	$ 0	$ 154	$ 117	$ 236	491	$ 117	$ 236	1,602	$ 813,000
Former LQG	$ 0	$ 159	$ 117	$ 243	205	$ 117	$ 243	668	$ 347,000
Subtotal									$ 1,160,000
Collectors									
Former SQG	$ 0	$ 0	$ 558	$ 3,436	48	$ 558	$ 3,436	50	$ 391,000
Former LQG	$ 0	$ 0	$ 1,135	$ 3,319	240	$ 1,135	$ 3,319	250	$ 2,182,000
Subtotal									$ 2,573,000
Total Cost to Regulated Generators									$ 1,315,000
Total Compliance Costs under the Primary Alternative									$ 19,502,000

Note: Total cost numbers rounded to nearest thousand. Costs may not add due to rounding.

4.2.2 Incremental Cost Difference Between the Subtitle C Baseline and the Primary Alternative

The primary alternative generates a net savings relative to the baseline, due primarily to reduced administrative requirements and savings from reduced transportation and disposal costs. Savings from the primary alternative accrue to former generators that would no longer be regulated. The range of potential savings under the primary alternative is estimated to be from $2,401,000[33] to $5,071,000,[34]

[33] Assumes a six year monitor life, an average monitor weight of 30 pounds, and 75 percent of discarded monitors are color.

[34] Assumes a two year monitor life, an average monitor weight of 41 pounds, and 90 percent of discarded monitors are color.

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with a best estimate of $4,840,000.[35] Exhibit 4-3 summarizes the costs under the baseline and the primary alternative by cost category.

Exhibit 4-3: Costs of Primary Alternative Relative to Subtitle C Baseline

Cost Category	Baseline	Primary Alternative	Saving (Cost)
Administrative	$ 1,888,000	$ 197,000	$ 1,691,000
Disposal	$ 16,373,000	$ 15,128,000	$ 1,245,000
Transportation	$ 5,431,000	$ 2,936,000	$ 2,495,000
Storage	$ 650,000	$ 1,241,000	$ (591,000)
Total	$ 24,342,000	$ 19,502,000	$ 4,840,000

Note: Cost numbers rounded to nearest thousand. Costs may not add due to rounding.

4.2.3 Sensitivity Analysis for the Primary Alternative

Individual sensitivity and bounding analysis is conducted on the difference between the Subtitle C baseline and the primary alternative for the following four parameters: monitor weight, monitor lifetime, storage costs, and percent of monitors that are color. Appendix G lists the parameters to which the analysis results are relatively insensitive. The individual sensitivity analysis is conducted by changing one parameter at a time while holding all other parameters at their best estimate value. Exhibit 4-4 contains the upper and lower bounds and the best estimate values for the four parameters as well as the percent change of the lower and upper bounds from the best estimate. The upper and lower bounds were selected because they represent probable limits on the selected parameters. Exhibit 4-5 contains the model results for each individual change. Exhibit 4-6 plots the data in Exhibit 4-5 from the individual sensitivity analysis for the four parameters. The graph illustrates that the analysis is most sensitive to the monitor weight, monitor lifetime, and the percent of color monitors discarded. The graph also indicates that the model results are not linearly related with respect to percent color, monitor weight, and monitor life, since the lines for these parameters are not straight. To determine a potential maximum upper bound on the savings, a combined sensitivity analysis is conducted using a monitor weight of 41 pounds, a monitor lifetime of 3.5 years, the percent of color monitors discarded of 90 percent, and storage cost of zero dollars per square foot. The savings under the combined sensitivity analysis is $5,723,000.

[35] Assumes a 3.5 year monitor life, an average monitor weight of 35 pounds, and 90 percent of discarded monitors are color.

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Exhibit 4-4: Parameter Values for Individual Sensitivity Analysis

	Lower Bound	% Change from Best Estimate	Best Estimate	Upper Bound	% Change from Best Estimate
Monitor Weight	30 lbs.	-14 %	35 lbs.	40 lbs.	14 %
Monitor Life	2 years	-43 %	3.5 years	5 years	43 %
Storage Cost	$ 0	-100 %	$ 8.30	$ 15	81 %
Percent Color	60 %	-33 %	90 %	99 %	10 %

Exhibit 4-5: Individual Sensitivity Analysis Results

	Lower Bound	Best Estimate	Upper Bound
Monitor Weight	$ 4,326,000	$ 4,840,000	$ 5,091,000
Monitor Life	$ 4,753,000	$ 4,840,000	$ 3,934,000
Storage Cost	$ 5,431,000	$ 4,840,000	$ 4,364,000
Percent Color	$ 3,861,000	$ 4,840,000	$ 4,871,000

Numbers rounded to nearest thousand.

Sensitivity analysis is also conducted for disposal costs above and below the best estimate values. By changing the cost for disposal to a hazardous waste landfill to $800 and $1700 per ton for whole CRTs (from a best estimate of $1,500), and to $50 and $250 per ton for crushed CRTs (from a best estimate of $160), the savings ranged from $5,141,000 to $4,175,000. By changing the cost for disposal to a reclaimer to $150 and $500 per ton for whole CRTs (from a best estimate of $295), to $100 and $300 per ton for bare CRTs (from a best estimate of $207), and to $75 and $250 per ton for crushed CRTs (from a best estimate of $152), the savings ranged from $4,642,000 to $4,990,000. By changing the cost for disposal to a collector to $100 and $350 per ton (from a best estimate of $271), the savings ranged from $4,821,000 to $4,879,000. The sensitivity analysis on disposal costs shows that the model is moderately sensitive to hazardous waste disposal costs and only slightly sensitive to the reclaimer and collector disposal costs.

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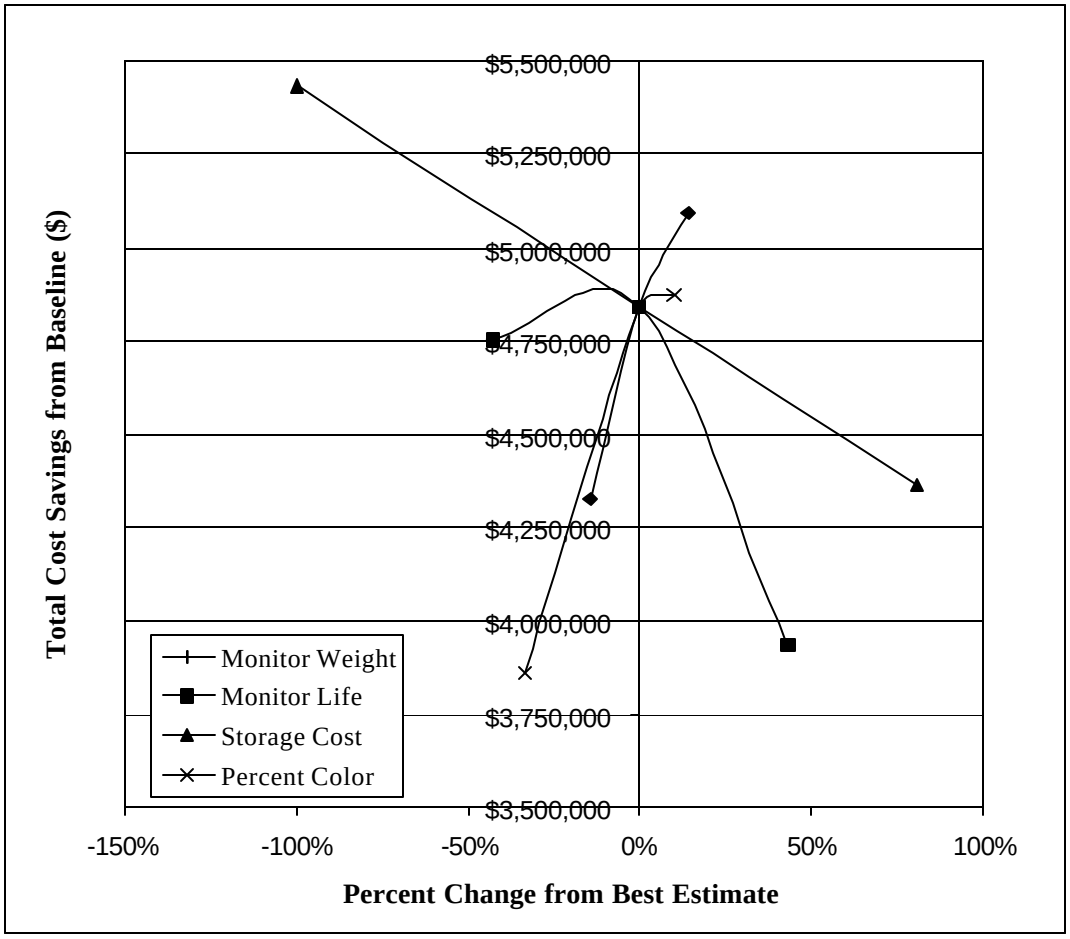
Exhibit 4-6: Plot of Individual Sensitivity Analysis Results for the Primary Alternative



Note: Lines with relatively steeper slopes indicate greater sensitivity of the results to changes (or uncertainty) in the given parameters.

4.2.4 Incremental Cost Difference Between the Subtitle C Baseline and the Primary Alternative, Including Currently Unregulated Monitors and Televisions

To help understand how the two regulatory alternatives might be affected by capacity issues, the total cost of compliance under the Subtitle C baseline and the primary alternative is calculated including CRTs from conditionally exempt small quantity generators (CESQG) and households. It is assumed that 20 million unregulated television CRTs are disposed and 16.7 million unregulated computer monitor CRTs are disposed from households and CESQGs.[36] Exhibit 4-7 contains a

[36] The number of televisions disposed of is based on the assumption that there are 100 million households each with two televisions and that the TVs are discarded after ten years. The 20 million TVs discarded is also consistent with the number of televisions sold in 1991, which was 19.5 million. The number of computer monitor CRTs disposed of is based on data from the

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summary of the costs under the baseline and the primary alternative by cost category. Disposal costs are higher under the primary alternative than the baseline because it is assumed that a greater percentage of unregulated CRTs are sent to collectors, which increases the number of CRTs that have a non-zero disposal cost under the primary alternative.

Exhibit 4-7: Costs of Primary Alternative Relative to Subtitle C Baseline, Including Unregulated Monitors and Televisions

Cost Category	Baseline	Primary Alternative	Saving (Cost)
Administrative	$ 1,984,000	$ 197,000	$ 1,787,000
Disposal	$ 20,854,000	$ 21,824,000	$ (970,000)
Transportation	$ 6,790,000	$ 5,893,000	$ 897,000
Storage	$ 650,000	$ 1,241,000	$ (591,000)
Total	$ 30,278,000	$ 29,155,000	$ 1,123,000

Note: Cost numbers rounded to nearest thousand. Costs may not add due to rounding.

The analysis estimates that 51,800 tons of CRT glass are sent to glass processors and that, of this, 50,700 tons of CRT glass are sent to CRT glass manufacturers. The quantity of CRTs sent to glass processors may be above the capacity limit for glass processors, since the capacity of one of the processors is not precisely known. The quantity sent to CRT glass manufacturers is below the capacity limits for CRT glass manufacturers. As the CRT recycling infrastructure grows and additional unregulated CRTs are recycled, the capacities of both glass processors and glass manufacturers will be exceeded. This analysis does not attempt to predict when this might occur.

4.3 CSI Alternative

4.3.1 Costs Under the CSI Alternative

The total applicable cost of compliance under the CSI alternative is calculated for all of the entities described in Section 4.1, and for all of the entities that were formerly generators but that no longer are required to comply with the hazardous waste regulations. These are called CSI handlers. Exhibit 4-8 presents the cost per CSI handler for administrative, storage, transportation, and disposal, and for the total cost of compliance under the CSI alternative. Administrative costs are assumed to be the same for all CSI handlers in each size category (small or large). The other costs vary across the categories (based on RCRA requirements for different types of generators, on the average number of

US Census, Survey of Computer Use, 1997, which estimates that 52 percent of households have computers.

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CRTs discarded, and on the CRT management method used by that generator). So Exhibit 4-8 presents the average cost for CSI handlers.

The average transportation and disposal cost for SQGs and LQGs changes between the baseline and the CSI alternative because, in the baseline, five CRT management options (collector, reuse, processor, smelter, and hazardous waste landfill) are available while in the CSI alternative only two CRT management options (lead smelter and hazardous waste landfill) are available for regulated generators, and only three of the CRT management options are available (collector, reuse, and processor) for CSI handlers.

Exhibit 4-8: CSI Alternative Compliance Costs Under the Subtitle C Baseline

	Average Costs per Generator				Number of Regulated Generators	Average Costs per Potentially Regulated Generator		Number of Potentially Regulated Generators	Total Cost
	Admin.	Storage	Transp.	Disposal		Transp.	Disposal		
CSI Handlers									
SQH	$ 100	$ 529	$ 125	$ 809	2,452	$ 125	$ 809	10,752	$ 13,874,000
LQH	$ 0	$ 0	$ 0	$ 0	0	$ 0	$ 0	0	$ 0
Subtotal									$ 13,874,000
Total Cost to Regulated Generators									7,371,000
Total Compliance Costs under the CSI Alternative									$ 21,244,000

Note: Total cost numbers rounded to nearest thousand. Costs may not add due to rounding.

4.3.2 Incremental Cost Difference Between the Subtitle C Baseline and the CSI Alternative

The CSI alternative generates a net savings relative to the baseline, due primarily to reduced administrative requirements and savings from reduced transportation and disposal costs. Savings from the CSI alternative accrue to CSI handlers that would no longer be regulated. The range of potential savings under the CSI alternative is estimated to be from $1,504,000[37] to $3,402,000,[38] with a best

[37] Assumes a six year monitor life, an average monitor weight of 35 pounds, and 75 percent of discarded monitors are color.

[38] Assumes a 3.5 year monitor life, an average monitor weight of 41 pounds, and 89 percent of discarded monitors are color.

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estimate of $3,098,000.[39] Exhibit 4-9 summarizes the costs under the baseline and the CSI alternative by cost category.

Exhibit 4-9: Costs of CSI Alternative Relative to Subtitle C Baseline

Cost Category	Baseline	Primary Alternative	Saving (Cost)
Administrative	$ 1,888,000	$ 826,000	$ 1,062,000
Disposal	$ 16,373,000	$ 15,356,000	$ 1,017,000
Transportation	$ 5,431,000	$ 3,667,000	$ 1,764,000
Storage	$ 650,000	$ 1,395,000	$ (745,000)
Total	$ 24,342,000	$ 21,244,000	$ 3,098,000

Note: Cost numbers rounded to nearest thousand. Costs may not add due to rounding.

4.3.3 Sensitivity Analysis for the CSI Alternative

Individual sensitivity and bounding analysis is conducted on the difference between the Subtitle C baseline and the CSI alternative for the following four parameters: monitor weight, monitor lifetime, storage costs, and percent of monitors that are color. Appendix G lists the parameters to which the analysis results are relatively insensitive. The individual sensitivity analysis is conducted by changing one parameter at a time while holding all other parameters at their best estimate value. Exhibit 4-10 contains the upper and lower bounds and the best estimate values for the four parameters as well as the percent change of the lower and upper bounds from the best estimate. The upper and lower bounds were selected because they represent probable limits on the selected parameters. Exhibit 4-11 contains the model results for each individual change. Exhibit 4-12 plots the data in Exhibit 4-11 from the individual sensitivity analysis for the four parameters. The graph illustrates that the analysis is most sensitive to the monitor weight, monitor lifetime, and the percent of color monitors discarded. The graph also indicates that the model results are not linearly related with respect to percent color, monitor weight, and monitor life, since the lines for these parameters are not straight. To determine a potential maximum upper bound on the savings, a combined sensitivity analysis is conducted using a monitor weight of 35 pounds, a monitor lifetime of 2 years, the percent of color monitors discarded of 99 percent, and storage cost of zero per square foot. The savings under the combined sensitivity analysis is $4,221,000.

[39] Assumes a 3.5 year monitor life, an average monitor weight of 35 pounds, and 90 percent of discarded monitors are color.

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Exhibit 4-10: Parameter Values for Individual Sensitivity Analysis

	Lower Bound	% Change from Best Estimate	Best Estimate	Upper Bound	% Change from Best Estimate
Monitor Weight	30 lbs.	-14 %	35 lbs.	40 lbs.	14 %
Monitor Life	2 years	-43 %	3.5 years	5 years	43 %
Storage Cost	$ 0	-100 %	$ 8.30	$ 15	81 %
Percent Color	60 %	-33 %	90 %	99 %	10 %

Exhibit 4-11: Individual Sensitivity Analysis Results

	Lower Bound	**Best Estimate**	**Upper Bound**
Monitor Weight	$ 2,677,000	$ 3,098,000	$ 3,365,000
Monitor Life	$ 2,735,000	$ 3,098,000	$ 2,386,000
Storage Cost	$ 3,843,000	$ 3,098,000	$2,496,000
Percent Color	$ 2,343,000	$ 3,098,000	$3,157,000

Numbers rounded to nearest thousand.

Sensitivity analysis is also conducted for disposal costs above and below the best estimate values. By changing the cost for disposal to a hazardous waste landfill to $800 and $1700 per ton for whole CRTs (from a best estimate of $1,500), and to $50 and $250 per ton for crushed CRTs (from a best estimate of $160), the savings ranged from $3,336,000 to $2,580,000. By changing the cost for disposal to a reclaimer to $150 and $500 per ton for whole CRTs (from a best estimate of $295), to $100 and $300 per ton for bare CRTs (from a best estimate of $207), and to $75 and $250 per ton for crushed CRTs (from a best estimate of $152), the savings ranged from $3,171,000 to $3,050,000. By changing the cost for disposal to a collector to $100 and $350 per ton (from a best estimate of $271), the savings ranged from $3,139,000 to $3,008,000. The sensitivity analysis on disposal costs shows that the model is moderately sensitive to hazardous waste disposal costs and only slightly sensitive to the reclaimer and collector disposal costs.

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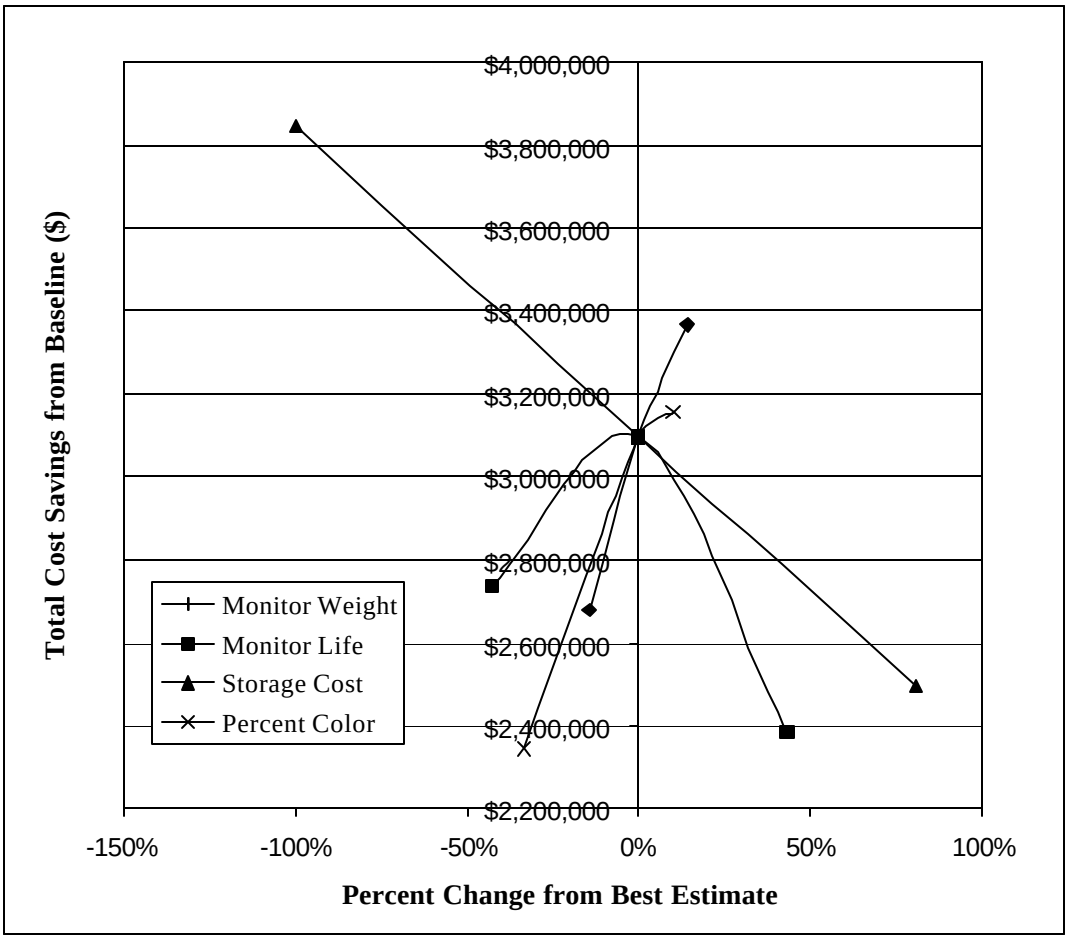
Exhibit 4-12: Plot of Individual Sensitivity Analysis Results for the CSI Alternative



Note: Lines with relatively steeper slopes indicate greater sensitivity of the results to changes (or uncertainty) in the given parameters.

4.3.4 Incremental Cost Difference Between the Subtitle C Baseline and the CSI Alternative, Including Currently Unregulated Monitors and Televisions

To help understand how the two regulatory alternatives might be affected by capacity issues, the total cost of compliance under the Subtitle C baseline and the CSI alternative is also calculated including CRTs from households and CESQGs. It is assumed that 20 million unregulated television CRTs are disposed and 16.7 million unregulated computer monitor CRTs are disposed from

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households and CESQGs.[40] Exhibit 4-13 contains a summary of the costs under the baseline and the CSI alternative by cost category.

Exhibit 4-13: Costs of CSI Alternative Relative to Subtitle C Baseline, Including Unregulated Monitors and Televisions

Cost Category	Baseline	CSI Alternative	Saving (Cost)
Administrative	$ 1,984,000	$ 855,000	$ 1,129,000
Disposal	$ 20,854,000	$ 18,834,000	$ 2,020,000
Transportation	$ 6,790,000	$ 4,988,000	$ 1,802,000
Storage	$ 650,000	$ 1,395,000	$ (745,000)
Total	$ 30,278,000	$ 26,072,000	$ 4,206,000

The analysis estimates that 32,000 tons of CRT glass is sent to glass processors and that, of this, 31,300 tons of CRT glass is sent to CRT glass manufacturers. These quantities are below the capacity limits for glass processors and CRT glass manufacturers. As the CRT recycling infrastructure grows and additional unregulated CRTs are recycled, the capacities of both glass processors and glass manufacturers will be exceeded. This analysis does not attempt to predict when this might occur.

5.0 Cost Results and Sensitivity Analysis for Subtitle D Management Baseline

The incremental annual savings attributable to both the primary alternative and the CSI alternative are calculated by subtracting the estimated costs under each alternative from the estimated costs under the Subtitle D baseline.

5.1 Costs Under the Subtitle D Baseline

The total applicable cost of the Subtitle D management baseline is calculated for several groups of entities. As shown in Exhibit 5-1, the analysis groups affected entities based on whether they are original users or collectors, the amount of waste they generate (SQGs or LQGs), and, for original users, whether they are regulated solely because of CRT generation or because of a combination of CRT and non-CRT hazardous waste generation. Collectors are all assumed to be regulated solely

[40] The number of televisions disposed of is based on the assumption that there are 100 million households each with two televisions and that the TVs are discarded after ten years. The 20 million TVs discarded is also consistent with the number of televisions sold in 1991, which was 19.5 million. The number of computer monitor CRTs disposed of is based on data from the US Census, Survey of Computer Use, 1997, which estimates that 52 percent of households have computers.

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because of CRT generation. Compliance costs also are calculated for glass processors. Exhibit 5-1 presents the cost per establishment for administrative, storage, transportation, and disposal, and for the total cost of compliance under the baseline. Administrative costs are assumed to be the same for all generators in each size category (small or large). The other costs vary across the categories (based on RCRA requirements for different types of generators, on the average number of CRTs discarded, and on the disposal method used by that generator). So Exhibit 5-1 presents the average cost for each group of generators. As discussed in Section 3.11, generators sending CRTs to Subtitle D landfills only incur a disposal cost.

Exhibit 5-1: Subtitle D Baseline Compliance Costs

	Average Costs per Generator					Number of Regulated Generators	Average Costs per Potentially Regulated Generator			Number of Potentially Regulated Generators	Total Cost
	Admin.	Storage	Transp.	Disposal Except Subtitle D	Subtitle D Disposal		Transp.	Disposal Except Subtitle D	Subtitle D Disposal		
Original Users (Generating No Non-CRT Hazardous Waste)											
SQG	$ 663	$ 1,304	$ 120	$ 1,139	$ 485	170	$ 120	$ 1,139	$ 485	2,260	$ 4,571,000
LQG	$ 1,327	$ 3,314	$ 682	$ 8,681	$ 3,696	5	$ 682	$ 8,681	$ 3,696	66	$ 950,000
Subtotal											$ 5,521,000
Original Users Also Generating Non-CRT Hazardous Waste											
SQG	$ 87	$ 386	$ 73	$ 768	$ 143	43	$ 73	$ 768	$ 143	384	$ 441,000
LQG	$ 325	$ 134	$ 182	$ 792	$ 148	18	$ 182	$ 792	$ 148	160	$ 208,000
Subtotal											$ 649,000
Collectors											
SQG	$ 647	$ 0	$ 234	$ 95	$ 50	10	$ 234	$ 95	$ 50	90	$ 44,000
LQG	$ 1,290	$ 0	$ 630	$ 166	$ 94	85	$ 630	$ 166	$ 94	415	$ 554,000
Subtotal											$ 598,000
Glass Processors											
	$ 1,284	$ 0	$ 1,542	$ (16,405)	N/A	5	N/A	N/A	N/A	N/A	$ (68,000)
Total Baseline Compliance Costs											$ 6,700,000

Note: Total cost numbers rounded to nearest thousand. Costs may not add due to rounding.

5.2 Primary Alternative

5.2.1 Costs Under the Primary Alternative

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The total applicable cost of compliance under the primary alternative is calculated for all of the entities described in Section 5.1, and for all of the entities that were formerly generators but that no longer are required to comply with the hazardous waste regulations. These are called "former generators." Exhibit 5-2 presents the cost per establishment for administrative, storage, transportation, and disposal, and for the total cost of compliance under the primary alternative. Administrative costs are assumed to be the same for all generators in each size category (small or large). The other costs vary across the categories (based on RCRA requirements for different types of generators, on the average number of CRTs discarded, and on the disposal method used by that generator). So Exhibit 5-2 presents the average cost for each group of generators. As discussed in section 3.11, generators sending CRTs to Subtitle D landfills only incur a disposal cost.

The average transportation and disposal cost for SQGs and LQGs changes between the baseline and the primary alternative because, in the baseline, six CRT management options (collector, reuse, processor, smelter, hazardous waste landfill, and municipal landfill) are available while in the primary alternative only one disposal option (hazardous waste landfill) is available for regulated generators and five of the CRT management options are available (collector, reuse, processor, smelter, hazardous waste landfill, and municipal landfill) for former generators. The reason for the changes in average collector costs is similar. Under the baseline, six CRT management options are available (reuse, processor, smelter, hazardous waste landfill, municipal landfill, and export). Under the primary alternative, the same six CRT management options are available for regulated collectors, while former generators have five CRT management options (reuse, municipal landfill, processor, smelter, and export).

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Exhibit 5-2: Primary Alternative Compliance Costs Under the Subtitle D Baseline

	Average Costs per Generator					Number of Regulated Generators	Average Costs per Potentially Regulated Generator			Number of Potentially Regulated Generators	Total Cost
	Admin.	Storage	Transp.	Disposal Except Subtitle D	Subtitle D Disposal		Transp.	Disposal Except Subtitle D	Subtitle D Disposal		
Original Users (Generating No Non-CRT Hazardous Waste)											
Former SQG	$ 0	$ 1,304	$ 119	$ 993	$ 455	121	$ 119	$ 993	$ 455	2,260	$ 3,888,000
Former LQG	$ 0	$ 3,295	$ 654	$ 7,527	$ 3,445	4	$ 654	$ 7,527	$ 3,445	66	$ 827,000
Subtotal											$ 4,715,000
Original Users Also Generating Non-CRT Hazardous Waste											
Former SQG	$ 0	$ 772	$ 47	$ 294	$ 134	34	$ 47	$ 294	$ 134	384	$ 225,000
Former LQG	$ 0	$ 798	$ 48	$ 304	$ 139	14	$ 48	$ 304	$ 139	160	$ 97,000
Subtotal											$ 322,000
Collectors											
Former SQG	$ 0	$ 0	$ 94	$ 199	$ 62	8	$ 94	$ 199	$ 62	90	$ 35,000
Former LQG	$ 0	$ 0	$ 120	$ 255	$ 137	75	$ 120	$ 255	$ 137	415	$ 251,000
Subtotal											$ 286,000
Total Cost to Regulated Generators											$ 1,484,000
Total Compliance Costs under the Primary Alternative											$ 6,806,000

Note: Total cost numbers rounded to nearest thousand. Costs may not add due to rounding.

5.2.2 Incremental Cost Difference Between the Subtitle D Baseline and the Primary Alternative

The primary alternative generates a net savings relative to the baseline, due primarily to reduced administrative requirements and savings from reduced transportation and disposal costs. Savings from the primary alternative accrue to former generators that would no longer be regulated. The range of potential savings under the primary alternative is estimated to be from a net cost of 1,301,000[41] to a net

[41] Assumes a two year monitor life, an average monitor weight of 40 pounds, and 95 percent of discarded monitors are color.

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savings of $291,000,[42] with a best estimate of a cost of $106,000.[43] Exhibit 5-3 summarizes the costs under the baseline and the primary alternative by cost category.

Exhibit 5-3: Costs of Primary Alternative Relative to Subtitle D Baseline

Cost Category	Baseline	Primary Alternative	Saving (Cost)
Administrative	$ 251,000	$ 56,000	$ 195,000
Disposal Except Subtitle D	$ 3,863,000	$ 4,485,000	$ (622,000)
Subtitle D Disposal	$ 1,580,000	$ 1,479,000	$ 101,000
Transportation	$ 749,000	$ 507,000	$ (242,000)
Storage	$ 257,000	$ 279,000	$ 22,000
Total	$ 6,700,000	$ 6,806,000	$ 106,000

Note: Cost numbers rounded to nearest thousand. Costs may not add due to rounding.

5.2.3 Sensitivity Analysis for the Primary Alternative

Individual sensitivity and bounding analysis is conducted on the difference between the Subtitle D baseline and the primary alternative for the following four parameters: monitor weight, monitor lifetime, storage costs, and percent of monitors that are color. The individual sensitivity analysis is conducted by changing one parameter at a time while holding all other parameters at their best estimate value. Exhibit 5-4 contains the upper and lower bounds and the best estimate values for the four parameters as well as the percent change of the lower and upper bounds from the best estimate. The upper and lower bounds were selected because they represent probable limits on the selected parameters. Exhibit 5-5 contains the model results for each individual change. Exhibit 5-6 plots the data in Exhibit 5-5 from the individual sensitivity analysis for the four parameters. The graph illustrates that the analysis is most sensitive to the monitor weight, monitor lifetime, and the percent of color monitors discarded. To determine a potential maximum upper bound on the savings, a combined sensitivity analysis is conducted using a monitor weight of 30 pounds, a monitor lifetime of 6 years, the percent of color monitors discarded of 85 percent, and storage cost of zero dollars per square foot. The savings under the combined sensitivity analysis is $349,000.

[42] Assumes a six year monitor life, an average monitor weight of 30 pounds, and 75 percent of discarded monitors are color.

[43] Assumes a three and one half year monitor life, an average monitor weight of 35 pounds, and 90 percent of discarded monitors are color.

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Exhibit 5-4: Parameter Values for Individual Sensitivity Analysis

	Lower Bound	% Change from Best Estimate	Best Estimate	Upper Bound	% Change from Best Estimate
Monitor Weight	30 lbs.	-14 %	35 lbs.	40 lbs.	14 %
Monitor Life	2 years	-43 %	3.5 years	5 years	43 %
Storage Cost	$ 0	-100 %	$ 8.30	$ 15	81 %
Percent Color	60 %	-33 %	90 %	99 %	10 %

Exhibit 5-5: Individual Sensitivity Analysis Results

	Lower Bound	**Best Estimate**	**Upper Bound**
Monitor Weight	$ 17,000	$ (106,000)	$ (247,000)
Monitor Life	$ (916,000)	$ (106,000)	$ 93,000
Storage Cost	$ (84,000)	$ (106,000)	$ (123,000)
Percent Color	$ 120,000	$ (106,000)	$ (191,000)

Note: Cost numbers rounded to nearest thousand.

Sensitivity analysis is also conducted for disposal costs above and below the best estimate values. By changing the cost for disposal to a hazardous waste landfill to $800 and $1700 per ton for whole CRTs (from a best estimate of $1,500), and to $50 and $250 per ton for crushed CRTs (from a best estimate of $160), the savings ranged from $ (61,000) to $(259,000). By changing the cost for disposal to a reclaimer to $150 and $500 per ton for whole CRTs (from a best estimate of $295), to $100 and $300 per ton for bare CRTs (from a best estimate of $207), and to $75 and $250 per ton for crushed CRTs (from a best estimate of $152), the savings ranged from $(330,000) to $54,000. By changing the cost for disposal to a collector to $100 and $350 per ton (from a best estimate of $271), the savings ranged from $(236,000) to $176,000. The sensitivity analysis on disposal costs shows that the model is moderately sensitive to hazardous waste, reclaimer, and collector disposal costs.

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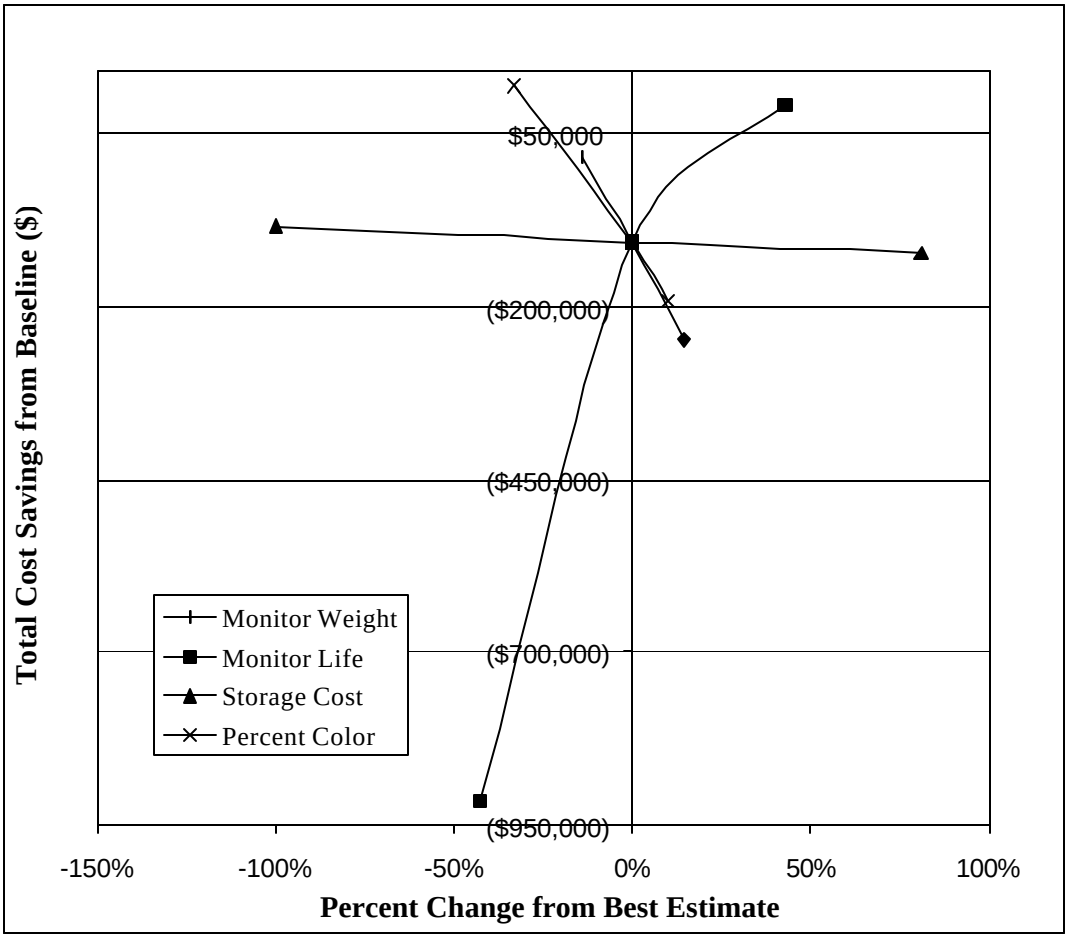
Exhibit 5-6: Plot of Individual Sensitivity Analysis Results for the Primary Alternative



Note: Lines with relatively steeper slopes indicate greater sensitivity of the results to changes (or uncertainty) in the given parameters.

5.2.4 Incremental Cost Difference Between the Subtitle D Baseline and the Primary Alternative, Including Currently Unregulated Monitors and Televisions

To help understand how the two regulatory alternatives might be affected by capacity issues, the total cost of compliance under the Subtitle D baseline and the primary alternative is also calculated including CRTs from households and CESQGs. It is assumed that 20 million unregulated television CRTs are disposed and 16.7 million unregulated computer monitor CRTs are disposed from households and CESQGs.[44] Exhibit 5-7 contains a summary of the costs under the baseline and the

[44] The number of televisions disposed of is based on the assumption that there are 100 million households each with two televisions and that the TVs are discarded after ten years. The 20

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primary alternative by cost category. Transportation and disposal costs are higher under the primary alternative than the baseline because it is assumed that a greater percentage of unregulated CRTs are sent to collectors, which increases the number of CRTs that have a non-zero disposal cost under the primary alternative.

Exhibit 5-7: Costs of Primary Alternative Relative to Subtitle D Baseline Including Unregulated Monitors and Televisions

Cost Category	Baseline	Primary Alternative	Saving (Cost)
Administrative	$ 269,000	$ 56,000	$ 213,000
Disposal Except Subtitle D	$ 6,155,000	$ 6,677,000	$ (522,000)
Subtitle D Disposal	$ 3,007,000	$ 2,789,000	$ 218,000
Transportation	$ 1,063,000	$ 1,213,000	$ (150,000)
Storage	$ 257,000	$ 279,000	$ (22,000)
Total	$ 10,751,000	$ 11,014,000	$ (263,000)

Note: Cost numbers rounded to nearest thousand. Costs may not add due to rounding.

The analysis estimates that 9,600 tons of CRT glass is sent to glass processors and that, of this, 8,800 tons of CRT glass is sent to CRT glass manufacturers. These quantities are below the capacity limits for glass processors and CRT glass manufacturers. As the CRT recycling infrastructure grows and additional unregulated CRTs are recycled, the capacities of both glass processors and glass manufacturers will be exceeded. This analysis does not attempt to predict when this might occur.

5.3 CSI Alternative

5.3.1 Costs Under the CSI Alternative

The total applicable cost of compliance under the CSI alternative is calculated for all of the entities described in Section 5.1, and for all of the entities that were formerly generators but that no longer are required to comply with the hazardous waste regulations. These are called CSI handlers. Exhibit 5-8 presents the cost per establishment for administrative, storage, transportation, and disposal, and for the total cost of compliance under the CSI alternative. Administrative costs are assumed to be the same for all CSI handlers in each size category (small or large). The other costs vary across the

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million TVs discarded is also consistent with the number of televisions sold in 1991, which was 19.5 million. The number of computer monitor CRTs disposed of is based on data from the US Census, Survey of Computer Use, 1997, which estimates that 52 percent of households have computers.

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categories (based on RCRA requirements for different types of generators, on the average number of CRTs discarded, and on the CRT management method used by that generator). So Exhibit 5-8 presents the average cost for CSI handlers. As discussed in section 3.11, generators sending CRTs to Subtitle D landfills only incur a disposal cost.

The average transportation and disposal cost for SQGs and LQGs changes between the baseline and the CSI alternative because, in the baseline, six CRT management options (collector, reuse, processor, smelter, hazardous waste landfill, and municipal landfill) are available while in the CSI alternative only three CRT management options (lead smelter, hazardous waste landfill, and municipal landfill) are available for regulated generators, and four of the CRT management options are available (collector, reuse, processor, and municipal landfill) for CSI handlers.

Exhibit 5-8: CSI Alternative Compliance Costs Under the Subtitle D Baseline

	Average Costs per Generator					Number of Regulated Generators	Average Costs per Potentially Regulated Generator			Number of Potentially Regulated Generators	Total Cost
	Admin.	Storage	Transp.	Disposal Except Subtitle D	Subtitle D Disposal		Transp.	Disposal Except Subtitle D	Subtitle D Disposal		
CSI Handlers											
SQH	$ 100	$ 883	$ 114	$ 900	$ 480	200	$ 114	$ 900	$ 480	2,439	$ 4,138,000
LQH	$ 0	$ 0	$ 0	$ 0	$ 0	0	$ 0	$ 0	$ 0	0	$ 0
Subtotal											$ 4,138,000
Total Cost to Regulated Generators											$ 2,996,000
Total Compliance Costs under the CSI Alternative											$ 7,134,000

Note: Total cost numbers rounded to nearest thousand. Costs may not add due to rounding.

5.3.2 Incremental Cost Difference Between the Subtitle D Baseline and the CSI Alternative

The CSI alternative generates a net savings relative to the baseline, due primarily to reduced administrative requirements and savings from reduced transportation and disposal costs. Savings from the CSI alternative accrue to CSI handlers that would no longer be regulated. The range of potential savings under the CSI alternative is estimated to be from a net cost of $1,521,000[45] to a net cost of

[45] Assumes a two year monitor life, an average monitor weight of 40 pounds, and 95 percent of discarded monitors are color.

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$33,000,[46] with a best estimate of a net cost of $434,000.[47] Exhibit 5-9 summarizes the costs under the baseline and the CSI alternative by cost category.

Exhibit 5-9: Costs of CSI Alternative Relative to Subtitle D Baseline

Cost Category	Baseline	Primary Alternative	Saving (Cost)
Administrative	$ 251,000	$ 129,000	$ 122,000
Disposal Except Subtitle D	$ 3,863,000	$ 4,435,000	$ (572,000)
Subtitle D Disposal	$ 1,580,000	$ 1,500,000	$ 80,000
Transportation	$ 749,000	$ 875,000	$ (126,000)
Storage	$ 257,000	$ 195,000	$ 62,000
Total	$ 6,700,000	$ 7,134,000	$ (434,000)

Note: Cost numbers rounded to nearest thousand. Costs may not add due to rounding.

5.3.3 Sensitivity Analysis for the CSI Alternative

Individual sensitivity and bounding analysis is conducted on the difference between the Subtitle D baseline and the CSI alternative for the following four parameters: monitor weight, monitor lifetime, storage costs, and percent of monitors that are color. The individual sensitivity analysis is conducted by changing one parameter at a time while holding all other parameters at their best estimate value. Exhibit 5-10 contains the upper and lower bounds and the best estimate values for the four parameters as well as the percent change of the lower and upper bounds from the best estimate. The upper and lower bounds were selected because they represent probable limits on the selected parameters. Exhibit 5-11 contains the model results for each individual change. Exhibit 5-12 plots the data in Exhibit 5-11 from the individual sensitivity analysis for the four parameters. The graph illustrates that the analysis is most sensitive to the monitor weight, monitor lifetime, and the percent of color monitors discarded. To determine a potential maximum upper bound on the savings, a combined sensitivity analysis is conducted using a monitor weight of 26 pounds, a monitor lifetime of 5.5 years, the percent of color monitors discarded of 75 percent, and storage cost of $15 per square foot. The savings under the combined sensitivity analysis is $5,000.

[46] Assumes a six year monitor life, an average monitor weight of 30 pounds, and 86 percent of discarded monitors are color.

[47] Assumes a three and one half year monitor life, an average monitor weight of 35 pounds, and 90 percent of discarded monitors are color.

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Exhibit 5-10: Parameter Values for Individual Sensitivity Analysis

	Lower Bound	% Change from Best Estimate	Best Estimate	Upper Bound	% Change from Best Estimate
Monitor Weight	30 lbs.	-14 %	35 lbs.	40 lbs.	14 %
Monitor Life	2 years	-43 %	3.5 years	5 years	43 %
Storage Cost	$ 0	-100 %	$ 8.30	$ 15	81 %
Percent Color	60 %	-33 %	90 %	99 %	10 %

Exhibit 5-11: Individual Sensitivity Analysis Results

	Lower Bound	Best Estimate	Upper Bound
Monitor Weight	$ (315,000)	$ (434,000)	$ (568,000)
Monitor Life	$ (1,153,000)	$ (434,000)	$ (259,000)
Storage Cost	$ (496,000)	$ (434,000)	$ (383,000)
Percent Color	$ (223,000)	$ (434,000)	$ (509,000)

Numbers rounded to nearest thousand.

Sensitivity analysis is also conducted for disposal costs above and below the best estimate values. By changing the cost for disposal to a hazardous waste landfill to $800 and $1700 per ton for whole CRTs (from a best estimate of $1,500), and to $50 and $250 per ton for crushed CRTs (from a best estimate of $160), the savings ranged from $(417,000) to $(499,000). By changing the cost for disposal to a reclaimer to $150 and $500 per ton for whole CRTs (from a best estimate of $295), to $100 and $300 per ton for bare CRTs (from a best estimate of $207), and to $75 and $250 per ton for crushed CRTs (from a best estimate of $152), the savings ranged from $(349,000) to $(493,000). By changing the cost for disposal to a collector to $100 and $350 per ton (from a best estimate of $271), the savings ranged from $(577,000) to $(255,000).

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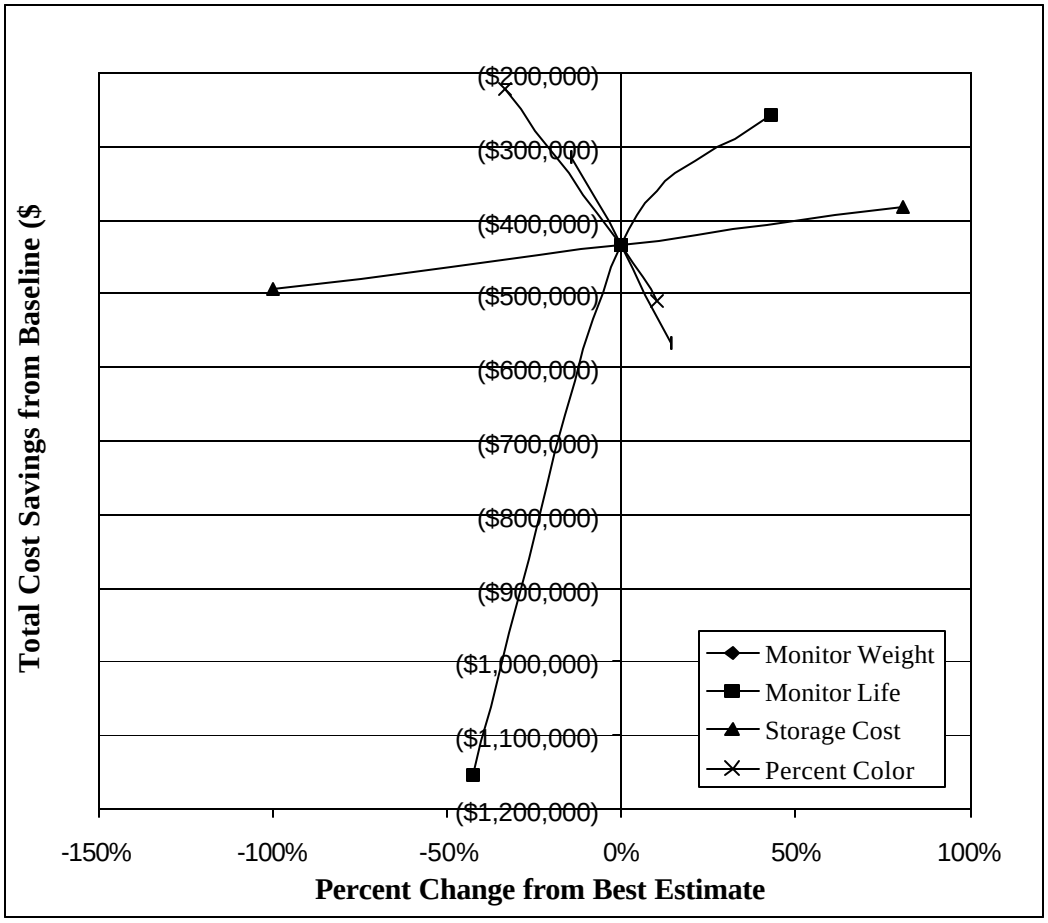
Exhibit 5-12: Plot of Individual Sensitivity Analysis Results for the CSI Alternative



Note: Lines with relatively steeper slopes indicate greater sensitivity of the results to changes (or uncertainty) in the given parameters.

5.3.4 Incremental Cost Difference Between the Subtitle D Baseline and the CSI Alternative, Including Currently Unregulated Monitors and Televisions

To help understand how the two regulatory alternatives might be affected by capacity issues, the total cost of compliance under the Subtitle D baseline and the CSI alternative is also calculated including CRTs from households and CESQGs. It is assumed that 20 million unregulated television CRTs are disposed and 16.7 million unregulated computer monitor CRTs are disposed from

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households and CESQGs.[48] Exhibit 5-13 summarizes the costs under the baseline and the CSI alternative by cost category.

Exhibit 5-13: Costs of CSI Alternative Relative to Subtitle D Baseline, Including Unregulated Monitors and Televisions

Cost Category	Baseline	Primary Alternative	Saving (Cost)
Administrative	$ 269,000	$ 136,000	$ 133,000
Disposal Except Subtitle D	$ 6,155,000	$ 6,934,000	$ (779,000)
Subtitle D Disposal	$ 3,007,000	$ 2,745,000	$ 262,000
Transportation	$ 1,063,000	$ 1,224,000	$ (161,000)
Storage	$ 257,000	$ 195,000	$ 62,000
Total	$ 10,751,000	$ 11,234,000	$ (483,000)

The analysis estimates that 9,600 tons of CRT glass is sent to glass processors and that, of this, 9,400 tons of CRT glass is sent to CRT glass manufacturers. These quantities are below the capacity limits for glass processors and CRT glass manufacturers. As the CRT recycling infrastructure grows and additional unregulated CRTs are recycled, the capacities of both glass processors and glass manufacturers will be exceeded. This analysis does not attempt to predict when this might occur.

6.0 Economic Impacts

This section presents the estimated first-order economic impacts associated with the incremental cost savings from the primary and CSI alternatives over the Subtitle C management baseline using the cost to sales ratio. As noted in Section 3.10, the impacts analysis is likely to overstate economic impacts (whether costs or savings) because the sales data used in the analysis represent average values for each SIC code as a whole, whereas the estimated compliance costs arise only for the entities that are large enough to be considered an SQG or LQG in the baseline. Such entities are likely to have an average sales value higher than the average for the industry as a whole.

[48] The number of televisions disposed of is based on the assumption that there are 100 million households each with two televisions and that the TVs are discarded after ten years. The 20 million TVs discarded is also consistent with the number of televisions sold in 1991, which was 19.5 million. The number of computer monitor CRTs disposed of is based on data from the US Census, Survey of Computer Use, 1997, which estimates that 52 percent of households have computers.

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Primary Alternative

Exhibit 6-1 shows the impacts of the cost savings for original users that were baseline small quantity generators (SQGs). Their average savings is $606 per year, due primarily to reduced administrative requirements and transportation savings. The highest impact on SQGs is on the "Personal Services" sector (SIC code 72). Establishments in SIC code 72 have average annual sales of $219,582. The incremental cost savings represents 0.28 percent of the average annual sales. Establishments in all but one other SIC code have impacts of less than 0.17 percent of the average annual sales.

Exhibit 6-2 presents the results for original users that were baseline large quantity generators (LQGs). Their average savings is $1,101 per year, due to reduced administrative requirements, and transportation and disposal costs. The LQGs under the baseline are in 25 SIC codes. The highest impact for LQHs is on the Retail Trade Administrative and Auxiliary category. The maximum incremental cost savings represents 0.30 percent of the average annual sales. Establishments in all other SIC codes have impacts of less than 0.23 percent of the average annual sales.

Exhibit 6-1: Estimated Impact of Savings Under the Primary Alternative on Former SQGs that were Baseline SQGs

Industry	SIC Code	Average Sales per Establishment	Number of Baseline Potential SQGs	Savings (Cost) Impact of Primary Alternative
MINING				
Metal Mining	10	$9,642,717	24	0.01%
Coal Mining	12	$8,841,349	21	0.01%
Oil & Gas Extraction	13	$5,338,313	52	0.01%
Non-metallic minerals, except fuels	14	$2,338,749	5	0.03%
Administrative & Auxiliary	1	$1,545,768	37	0.04%
CONSTRUCTION				
General contractors	15	$1,280,404	8	0.05%
Heavy construction	16	$2,570,507	24	0.02%
Special trade contractors	17	$590,600	5	0.10%
MANUFACTURING				
Food & kindred products	20	$19,567,362	178	0.00%
Tobacco products	21	$308,752,632	10	0.00%
Textile mill products	22	$12,020,557	56	0.01%
Apparel & other textile products	23	$3,103,014	9	0.02%
Lumber & wood products	24	$2,277,901	3	0.03%
Furniture & Fixtures	25	$3,759,298	30	0.02%
Paper & allied products	26	$20,760,708	208	0.00%

Industry	SIC Code	Average Sales per Establishment	Number of Baseline Potential SQGs	Savings (Cost) Impact of Primary Alternative
Printing & publishing	27	$2,540,878	328	0.02%
Chemicals & allied products	28	$25,443,194	297	0.00%
Petroleum and Coal Products	29	$70,728,296	44	0.00%
Rubber & miscellaneous plastics products	30	$7,170,357	225	0.01%
Leather & leather products	31	$4,751,863	5	0.01%
Stone, clay, and glass products	32	$3,846,475	22	0.02%
Primary metal industries	33	$21,271,651	72	0.00%
Fabricated metal products	34	$4,571,413	62	0.01%
Industrial machinery & equipment	35	$4,793,932	483	0.01%
Electronic & other electronic equipment	36	$12,809,615	578	0.00%
Transportation equipment	37	$35,374,262	459	0.00%
Instrument & related products	38	$11,884,834	121	0.01%
Miscellaneous manufacturing	39	$2,318,656	19	0.03%
Administrative & Auxiliary	1	$3,156,356	212	0.02%
TRANSPORTATION				
Local & Interurban passenger transit	41	$ 710,436	7	0.09%
Trucking & Warehousing	42	$1,296,519	98	0.05%
Water transportation	44	$3,585,027	16	0.02%
Transportation by Air	45	$2,338,134	78	0.03%
Pipelines, except natural gases	46	$8,368,550	1	0.01%
Communication	48	$5,877,769	303	0.01%
Electronic, gas, & sanitary services	49	$15,510,062	255	0.00%
Administrative & Auxiliary	1	$1,766,775	43	0.03%
WHOLESALE				
Wholesale trade-durable goods	50	$5,084,711	168	0.01%
Wholesale trade-nondurable goods	51	$9,036,867	213	0.01%
Bldg. Materials & garden supplies	52	$1,422,393	1	0.04%
Administrative & Auxiliary	1	$781,548	98	0.08%
RETAIL TRADE				
General merchandise store	53	$7,089,224	28	0.01%
Food stores	54	$2,044,651	2	0.03%
Auto dealers & service station	55	$4,100,193	1	0.01%
Apparel & accessory stores	56	$699,117	4	0.09%
Furniture & home furnishing stores	57	$846,766	2	0.07%
Eating & drinking places	58	$450,446	6	0.13%
Miscellaneous retail	59	$607,995	31	0.10%
Administrative & Auxiliary	1	$370,918	96	0.16%

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Industry	SIC Code	Average Sales per Establishment	Number of Baseline Potential SQGs	Savings (Cost) Impact of Primary Alternative
FINANCE, INSURANCE, AND REAL ESTATE				
Depository Institution	60	$5,091,211	339	0.01%
Nondepository Institution	61	$3,432,819	87	0.02%
Security & commodity brokers	62	$3,491,738	86	0.02%
Insurance carriers	63	$20,422,940	482	0.00%
Insurance agents, brokers, & servicers	64	$424,989	27	0.14%
Real Estate	65	$617,331	74	0.10%
Holding & other investment offices	67	$3,237,932	37	0.02%
Administrative & Auxiliary	1	$1,054,687	23	0.06%
SERVICES				
Personal services	72	$219,582	6	0.28%
Business services	73	$896,726	1,432	0.07%
Auto repair, services, and parking	75	$407,237	1	0.15%
Misc. repair services	76	$429,359	2	0.14%
Motion picture	78	$1,040,439	15	0.06%
Amusement & recreation services	79	$793,715	69	0.08%
Health services	80	$677,073	3,177	0.09%
Legal services	81	$641,030	52	0.09%
Educational services	82	$491,509	580	0.12%
Social services	83	$225,786	18	0.27%
Museums, botanical, zoological gardens	84	$611,305	3	0.10%
Membership organization	86	$500,857	83	0.12%
Engineering & management service	87	$827,956	365	0.07%
Services, n.e.c	89	$546,119	8	0.11%
Administrative & Auxiliary	1	$1,053,680	134	0.06%

Exhibit 6-2: Estimated Impact of Savings Under the Primary Alternative on Former LQGs that were Baseline LQGs

Industry	SIC Code	Average Sales per Establishment	Number of Baseline Potential LQGs	Savings (Cost) Impact of Primary Alternative
MANUFACTURING				
Food and kindred products	20	$19,567,362	3	0.01%
Tobacco products	21	$308,752,632	1	0.00%
Chemicals & allied products	28	$25,443,194	4	0.01%
Primary metal industries	33	$21,271,651	5	0.01%

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Industry	SIC Code	Average Sales per Establishment	Number of Baseline Potential LQGs	Savings (Cost) Impact of Primary Alternative
Industrial machinery & equipment	35	$4,793,932	7	0.02%
Electronic & other electronic equipment	36	$12,809,615	12	0.01%
Transportation equipment	37	$35,374,262	51	0.00%
TRANSPORTATION				
Local & Interurban passenger transit	41	$710,436	1	0.16%
Trucking & Warehousing	42	$1,296,519	12	0.08%
Transportation by Air	45	$2,338,134	20	0.05%
Communication	48	$5,877,769	11	0.02%
Electronic, gas, & sanitary services	49	$15,510,062	4	0.01%
Administrative & Auxiliary	1	$1,766,775	5	0.06%
WHOLESALE				
Administrative & Auxiliary	1	$781,548	1	0.14%
RETAIL TRADE				
Food stores	54	$2,044,651	1	0.05%
Administrative & Auxiliary	1	$370,918	1	0.30%
FINANCE, INSURANCE, AND REAL ESTATE				
Depository Institution	60	$5,091,211	18	0.02%
Nondepository institution	61	$3,432,819	5	0.03%
Security and commodity brokers	62	$3,491,738	5	0.03%
Insurance carriers	63	$20,422,940	14	0.01%
Holding and other investment offices	67	$3,237,932	3	0.03%
SERVICES				
Business services	73	$896,726	22	0.12%
Motion picture	78	$1,040,439	5	0.11%
Amusement & recreation services	79	$793,715	3	0.14%
Health services	80	$677,073	65	0.16%
Educational services	82	$491,509	33	0.22%
Membership organization	86	$500,857	6	0.22%
Engineering & management service	87	$827,956	31	0.13%
Administrative & Auxiliary	1	$1,053,680	7	0.10%

CSI Alternative

Exhibit 6-3 shows the impacts of the cost savings for small quantity handlers (SQHs) that were baseline small quantity generators (SQGs). Their average savings is $498 per year, due primarily to reduced administrative requirements and transportation savings. The highest impact on SQGs is on the

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"Personal Services" sector (SIC code 72). Establishments in SIC code 72 have average annual sales of $219,582. The incremental cost savings represents 0.23 percent of the average annual sales. Establishments in all but one other SIC codes have impacts of less than 0.14 percent of the average annual sales.

Exhibit 6-4 presents the results for the small quantity handlers (SQHs) that were baseline large quantity generators (LQGs). Their average savings is $8,017 per year, due primarily to reduced administrative requirements and disposal costs. Fifteen percent of the LQGs under the baseline are assumed to continue following RCRA regulations because they send their waste to destinations other than glass processors. These establishments realize no cost savings under the CSI alternative. The former LQGs are regulated as SQHs under the CSI alternative, and are the main beneficiaries of the regulatory burden reduction.

The model estimates that no large quantity handlers will exist under the CSI alternative. Thus, the baseline large quantity generators that become SQHs by sending discarded CRTs to processors under the CSI alternative realize the most cost savings. The LQGs under the baseline are in 25 SIC codes. The highest impact for LQHs is on the Retail Trade Administrative and Auxiliary category. The maximum incremental cost savings represents 2.16 percent of the average annual sales. Establishments in all other SIC codes have impacts of less than 1.64 percent of the average annual sales.

Exhibit 6-3: Estimated Impact of Savings Under the CSI Alternative on Small Quantity Handlers that were Baseline SQGs

Industry	SIC Code	Average Sales per Establishment	Number of Baseline Potential SQGs	Savings (Cost) Impact of Primary Alternative
MINING				
Metal Mining	10	$9,642,717	24	0.01%
Coal Mining	12	$8,841,349	21	0.01%
Oil & Gas Extraction	13	$5,338,313	52	0.01%
Non-metallic minerals, except fuels	14	$2,338,749	5	0.02%
Administrative & Auxiliary	1	$1,545,768	37	0.03%
CONSTRUCTION				
General contractors	15	$1,280,404	8	0.04%
Heavy construction	16	$2,570,507	24	0.02%
Special trade contractors	17	$590,600	5	0.08%
MANUFACTURING				
Food & kindred products	20	$19,567,362	178	0.00%
Tobacco products	21	$308,752,632	10	0.00%
Textile mill products	22	$12,020,557	56	0.00%
Apparel & other textile products	23	$3,103,014	9	0.02%
Lumber & wood products	24	$2,277,901	3	0.02%

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Industry	SIC Code	Average Sales per Establishment	Number of Baseline Potential SQGs	Savings (Cost) Impact of Primary Alternative
Furniture & Fixtures	25	$3,759,298	30	0.01%
Paper & allied products	26	$20,760,708	208	0.00%
Printing & publishing	27	$2,540,878	328	0.02%
Chemicals & allied products	28	$25,443,194	297	0.00%
Petroleum and Coal Products	29	$70,728,296	44	0.00%
Rubber & miscellaneous plastics products	30	$7,170,357	225	0.01%
Leather & leather products	31	$4,751,863	5	0.01%
Stone, clay, and glass products	32	$3,846,475	22	0.01%
Primary metal industries	33	$21,271,651	72	0.00%
Fabricated metal products	34	$4,571,413	62	0.01%
Industrial machinery & equipment	35	$4,793,932	483	0.01%
Electronic & other electronic equipment	36	$12,809,615	578	0.00%
Transportation equipment	37	$35,374,262	459	0.00%
Instrument & related products	38	$11,884,834	121	0.00%
Miscellaneous manufacturing	39	$2,318,656	19	0.02%
Administrative & Auxiliary	1	$3,156,356	212	0.02%
TRANSPORTATION				
Local & Interurban passenger transit	41	$ 710,436	7	0.07%
Trucking & Warehousing	42	$1,296,519	98	0.04%
Water transportation	44	$3,585,027	16	0.01%
Transportation by Air	45	$2,338,134	78	0.02%
Pipelines, except natural gases	46	$8,368,550	1	0.01%
Communication	48	$5,877,769	303	0.01%
Electronic, gas, & sanitary services	49	$15,510,062	255	0.00%
Administrative & Auxiliary	1	$1,766,775	43	0.03%
WHOLESALE				
Wholesale trade-durable goods	50	$5,084,711	168	0.01%
Wholesale trade-nondurable goods	51	$9,036,867	213	0.01%
Bldg. Materials & garden supplies	52	$1,422,393	1	0.04%
Administrative & Auxiliary	1	$781,548	98	0.06%
RETAIL TRADE				
General merchandise store	53	$7,089,224	28	0.01%
Food stores	54	$2,044,651	2	0.02%
Auto dealers & service station	55	$4,100,193	1	0.01%
Apparel & accessory stores	56	$699,117	4	0.07%
Furniture & home furnishing stores	57	$846,766	2	0.06%
Eating & drinking places	58	$450,446	6	0.11%

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Industry	SIC Code	Average Sales per Establishment	Number of Baseline Potential SQGs	Savings (Cost) Impact of Primary Alternative
Miscellaneous retail	59	$607,995	31	0.08%
Administrative & Auxiliary	1	$370,918	96	0.13%
FINANCE, INSURANCE, AND REAL ESTATE				
Depository Institution	60	$5,091,211	339	0.01%
Nondepository Institution	61	$3,432,819	87	0.01%
Security & commodity brokers	62	$3,491,738	86	0.01%
Insurance carriers	63	$20,422,940	482	0.00%
Insurance agents, brokers, & servicers	64	$424,989	27	0.12%
Real Estate	65	$617,331	74	0.08%
Holding & other investment offices	67	$3,237,932	37	0.02%
Administrative & Auxiliary	1	$1,054,687	23	0.05%
SERVICES				
Personal services	72	$219,582	6	0.23%
Business services	73	$896,726	1,432	0.06%
Auto repair, services, and parking	75	$407,237	1	0.12%
Misc. repair services	76	$429,359	2	0.12%
Motion picture	78	$1,040,439	15	0.05%
Amusement & recreation services	79	$793,715	69	0.06%
Health services	80	$677,073	3,177	0.07%
Legal services	81	$641,030	52	0.08%
Educational services	82	$491,509	580	0.10%
Social services	83	$225,786	18	0.22%
Museums, botanical, zoological gardens	84	$611,305	3	0.08%
Membership organization	86	$500,857	83	0.10%
Engineering & management service	87	$827,956	365	0.06%
Services, n.e.c	89	$546,119	8	0.09%
Administrative & Auxiliary	1	$1,053,680	134	0.05%

Exhibit 6-4: Estimated Impact of Savings Under the CSI Alternative on Small Quantity Handlers that were Baseline LQGs

Industry	SIC Code	Average Sales per Establishment	Number of Baseline Potential LQGs	Savings (Cost) Impact of Primary Alternative
MANUFACTURING				
Food and kindred products	20	$19,567,362	3	0.04%
Tobacco products	21	$308,752,632	1	0.00%

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Industry	SIC Code	Average Sales per Establishment	Number of Baseline Potential LQGs	Savings (Cost) Impact of Primary Alternative
Chemicals & allied products	28	$25,443,194	4	0.03%
Primary metal industries	33	$21,271,651	5	0.04%
Industrial machinery & equipment	35	$4,793,932	7	0.17%
Electronic & other electronic equipment	36	$12,809,615	12	0.06%
Transportation equipment	37	$35,374,262	51	0.02%
TRANSPORTATION				
Local & Interurban passenger transit	41	$710,436	1	1.13%
Trucking & Warehousing	42	$1,296,519	12	0.62%
Transportation by Air	45	$2,338,134	20	0.34%
Communication	48	$5,877,769	11	0.14%
Electronic, gas, & sanitary services	49	$15,510,062	4	0.05%
Administrative & Auxiliary	1	$1,766,775	5	0.45%
WHOLESALE				
Administrative & Auxiliary	1	$781,548	1	1.03%
RETAIL TRADE				
Food stores	54	$2,044,651	1	0.39%
Administrative & Auxiliary	1	$370,918	1	2.16%
FINANCE, INSURANCE, AND REAL ESTATE				
Depository Institution	60	$5,091,211	18	0.16%
Nondepository institution	61	$3,432,819	5	0.23%
Security and commodity brokers	62	$3,491,738	5	0.23%
Insurance carriers	63	$20,422,940	14	0.04%
Holding and other investment offices	67	$3,237,932	3	0.25%
SERVICES				
Business services	73	$896,726	22	0.89%
Motion picture	78	$1,040,439	5	0.77%
Amusement & recreation services	79	$793,715	3	1.01%
Health services	80	$677,073	65	1.18%
Educational services	82	$491,509	33	1.63%
Membership organization	86	$500,857	6	1.60%
Engineering & management service	87	$827,956	31	0.97%
Administrative & Auxiliary	1	$1,053,680	7	0.76%

* The only LQGs under the CSI Alternative are those required to follow RCRA regulations because they send their waste to destinations other than Glass-to-Glass recyclers. Eighty-five percent of the Baseline LQGs are regulated as SQHs under the proposed rule, the others remain RCRA LQGs and therefore realize no cost savings.

7.0 Qualitative Environmental Benefits

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The shift of waste CRTs from landfills and incinerators to glass processors, and thus to CRT glass manufacturers, has four major potential qualitative environmental benefits. The four potential qualitative benefits are (1) increase in the availability of landfill space; (2) increase in resource efficiency; (3) increase in recycling by non-regulated entities; and (4) reduction of lead emissions from incinerators. This section discusses these four qualitative environmental benefits.

Landfill Capacity

A qualitative benefit of both alternatives is the shift of CRTs from Subtitle C and D landfills to CRT glass processors. The analysis estimates that approximately 2,600 tons or 456,000 cubic feet of CRTs will be redirected away from landfills each year under the primary alternative. This additional space can be used for other waste. By not disposing of CRTs in Subtitle C and D landfills, the landfill capacity will not be reached as quickly and new landfills will not be needed as soon. This unused Subtitle C and D landfill capacity is seen as a minor qualitative benefit, because so few regulated CRTs currently are being sent to these landfills.

Increase in Resource Efficiency

The resources that could be used more efficiently under the two regulatory alternatives include energy, CRT glass, raw materials for glass manufacturing, and landfill space. The amount of energy required to turn discarded televisions and computer monitors into an input for CRT glass manufacturers may be less than the energy required to mine, process, and transport the raw materials for glass making. Discarded CRTs are a direct replacement for raw materials to glass manufacturing, thus reserving those raw materials for future use.

Recycling by Non-Regulated Entities

The alternatives are designed to stimulate an increase in glass-to-glass CRT recycling in certain effected entities (i.e., firms that disposition a sufficient number of CRTs that they could potentially qualify as SQGs or LQGs). If the initiative is successful, the glass-to-glass recycling industry may develop and expand its operations. As CRT recycling infrastructure develops, it will become a more attractive option for smaller entities and for the general public. Thus, some additional entities may shift the management of their waste from Subtitle D landfills to glass recycling. This shift has the benefit of saving additional landfill space, and provides for more environmentally sound disposal of unregulated CRTs. The increased recycling infrastructure is already proving itself to be a valuable incentive for increased non-regulated CRT recycling in states such as Massachusetts and Minnesota.

Reduction of Lead Emissions

Exposure to lead may result in health problems to adults and children. These effects include hypertension, stroke, cancer in adults and decreased IQ and gestational age, reduced birth weight, and other neurological effects in infants and children. By shifting disposal of CRTs from municipal waste incinerators, the total lead emitted from CRT incineration can be reduced. However, the benefits of

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reducing lead emissions from CRT incineration are reported to be small.[49] One report estimates that the value of the health effects due to a complete ban on incineration of any CRTs is on the order of $5 million.[50]

8.0 Other Administrative Requirements

This section describes the Agency's response to other rulemaking requirements established by statute and executive order, within the context of the proposed rule for CRTs.

8.1 Environmental Justice

The EPA is committed to addressing environmental justice concerns and is assuming a leadership role in environmental justice initiatives to enhance environmental quality for all residents of the United States. The Agency's goals are to ensure that no segment of the population, regardless of race, color, national origin, or income bears disproportionately high and adverse human health and environmental impacts as a result of the EPA's policies, programs, and activities, and that all people live in clean and sustainable communities. In response to Executive Order 12898 and to concerns voiced by many groups outside the Agency, the EPA's Office of Solid Waste and Emergency Response formed an Environmental Justice Task Force to analyze the array of environmental justice issues specific to waste programs and to develop an overall strategy to identify and address these issues (OSWER Directive No. 9200.3-17).

Because CRTs are ubiquitous, it is not certain whether the environmental problems addressed by the proposed rule could disproportionately affect minority or low income communities. CRTs are used throughout the country and many are located within highly populated areas. Because the proposed rule establishes general environmental performance requirements to minimizes breakage, and helps prevent the release of glass particulates, the Agency does not believe that this rule will increase risks from CRT wastes. Moreover, the CSI alternative establishes an environmental justice procedure for new CRT processors. The procedure calls for new processors to advise the local community through notice and possibly public meeting regarding the nature of the activities conducted, including the potential for residential or worker exposure to lead or chemical coatings. It is, therefore, not expected to result in any disproportionately negative impacts on minority or low income communities relative to affluent or non-minority communities.

[49] Macauley et al., 2001, page 51.

[50] Macauley et al., 2001, page 45.

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8.2 Unfunded Mandates Reform Act

Under Section 202 of the Unfunded Mandates Reform Act of 1995, signed into law on March 22, 1995, the EPA must prepare a statement to accompany any rule for which the estimated costs to state, local, or tribal governments in the aggregate, or to the private sector, will be $100 million or more in any one year. Under Section 205, the EPA must select the most cost-effective and least burdensome alternative that achieves the objective of the rule and is consistent with statutory requirements. Section 203 requires the EPA to establish a plan for informing and advising any small governments that may be significantly affected by the rule.

An analysis of the costs and benefits of the proposed rule was conducted and it was determined that this rule does not include a federal mandate that may result in estimated costs of $100 million or more to either state, local, or tribal governments in the aggregate. The private sector also is not expected to incur costs exceeding $100 million per year in this EA.

8.3 Protection of Children from Environmental Health Risks and Safety Risks

Executive Order 13045, entitled "Protection of Children from Environmental Health Risks and Safety Risks" requires all economically significant rules[51] that concern an environmental health risk or safety risk that may disproportionately affect children to comply with requirements of the Executive Order. Because the EPA does not consider the proposed rule to be economically significant, it is not subject to Executive Order 13045. Because this rulemaking establishes general environmental performance requirements, minimizes breakage, and prevents of release of glass particulates, the EPA believes that the proposed rule will not result in increased exposures to children. For these reasons, the environmental health risks or safety risks addressed by this action do not have a disproportionate effect on children.

8.4 Regulatory Flexibility

The Regulatory Flexibility Act (RFA), as amended by the Small Business Regulatory Enforcement and Fairness Act, 5 U.S.C. §§ 601-612, generally requires an agency to conduct a regulatory flexibility analysis of any rule subject to notice and comment rulemaking requirements unless the agency certifies that the rule will not have a significant economic impact on a substantial number of small entities. Small entities include small businesses, small not-for-profit enterprises, and small governmental jurisdictions. This proposed rule does not have a significant impact on a substantial number of small entities because today's proposed rule relieves regulatory burden for CRT handlers through reduced regulatory requirements. In addition, the Agency estimates that this proposed rule

[51] An economically significant rule is defined by Executive Order 12866 as any rulemaking that has an annual effect on the economy of $100 million or more, or adversely affects in a material way the economy, a sector of the economy, productivity, competition, jobs, the environment, public health, or safety, or State, local, or tribal governments or communities.

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leads to an overall cost savings in the range of $4 to 5 million annually. Accordingly, EPA believes that the rule will not have a significant economic impact on a substantial number of small entities.

9.0 Discussion of Findings and Summary

The main conclusion of this analysis is that both the overall savings and the savings for individual establishments are small, and that the results are sensitive to a few key parameters (CRT life in businesses, the average weight of CRTs, storage costs, and the percent of color monitors discarded). A second conclusion is that both the glass processing and CRT glass manufacturer capacities are adequate to handle all regulated CRTs. However, if a new rule induces significantly more unregulated CRTs to be recycled than is modeled in this analysis, then both the glass processing and CRT glass manufacturer capacities may become inadequate to handle this larger volume of CRT glass.

The primary alternative, as modeled in this analysis, is expected to impact approximately 2,900 establishments in 66 different two-digit SIC codes. Under the Subtitle C baseline the proposed rule will lead to total savings of approximately $4,840,000 for current generators that elect not to send their discarded CRTs for disposal. These savings are due primarily to reduced administrative, disposal, and transportation costs. Under the Subtitle D baseline the proposed rule will lead to a total savings of approximately $106,000, due to reduced administrative and transportation costs.

The CSI alternative, as modeled in this analysis, is expected to impact approximately 2,500 establishments in 66 different two-digit SIC codes. Under the Subtitle C baseline the proposed rule will lead to total savings of approximately $3,098,000 for current generators that elect not to send their discarded CRTs for disposal. These savings are due primarily to reduced administrative, disposal, and transportation costs. Under the Subtitle D baseline the proposed rule will lead to a total savings of approximately $434,000, due to reduced administrative and transportation costs.

Relative to the Subtitle C baseline, the economic impacts on the entities in the regulated community are expected to be negligible because the rule provides savings for all entities managing CRTs. A significant benefit of the proposed rule is the possible increase in glass-to-glass recycling by the non-regulated community.

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Appendices

Appendix A: Number of Establishments and the Number of Employees for all Two-Digit SIC Codes

Appendix B: Ratios of Computers per Employee Calculated for Each SIC Code

Appendix C: Disposal Cost Source Details

Appendix D: Flow of CRTs in Both Number and Tons

Appendix E: Average Shipment Sizes for Each Type of Establishment Distributing CRTs to Each CRT Management Option

Appendix F: Revenues per Establishment for All Two-Digit SIC Codes

Appendix G: List of Parameters to Which the Analysis Results are Relatively Insensitive

Appendix H: Telephone Contacts

Appendix I: Bibliography

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Appendix A

Total Employees, Establishments, and Number of Establishments by Number of Employees, and by 2-Digit SIC Code

Industry	SIC code	Total Employees	Total Est.	Number of Establishments per Employee Size Range					
				250 to 499	500 to 999	1,000 to 1,499	1,500 to 2,499	2,500 to 4,999	5,000 or more
AGRICULTURE									
Agricultural services	7	595,842	103,543	51	18	4	1		
Forestry	8	20,488	2,512	4	1	1			
Fishing, hunting, trapping	9	11,871	2,236	5	0	1			
Administrative & Auxiliary	-	0	62	2	0				
MINING									
Metal Mining	10	48,105	921	20	16	5	3		
Coal Mining	12	104,204	2,294	82	21				
Oil & Gas Extraction	13	295,990	17,513	87	37	10	5		
Non-metallic minerals, except fuels	14	99,182	5,572	18	3	2			
Administrative & Auxiliary	-	80,002	1,056	48	29	6	1	1	
CONSTRUCTION									
General contractors	15	1,222,061	190,316	141	49	10	5	2	1
Heavy construction	16	707,811	34,168	174	60	13	11	8	5
Special trade contractors	17	3,091,307	409,114	325	66	9	5		
Administrative & Auxiliary	-	17,660	402	11	3				
MANUFACTURING									
Food & kindred products	20	1,525,070	21,285	872	408	118	50	10	3
Tobacco products	21	30,411	112	16	4	1	5		1
Textile mill products	22	624,005	6,452	492	200	38	11	7	
Apparel & other textile products	23	910,919	24,216	513	186	19	7	2	
Lumber & wood products	24	730,144	37,601	254	50	9	1	3	
Furniture & Fixtures	25	505,956	11,611	291	113	16	9	4	1
Paper & allied products	26	634,737	6,552	305	153	40	15		
Printing & publishing	27	1,505,794	64,690	531	200	78	37	13	
Chemicals & allied products	28	826,839	12,328	352	190	58	35	14	4
Petroleum and coal products	29	111,369	2,042	53	26	12	6		
Rubber & miscellaneous plastics products	30	1,001,010	16,611	526	169	26	26	4	
Leather & leather products	31	95,151	1,957	68	23	3	2		
Stone, clay, and glass products	32	491,795	16,214	190	75	16	6		
Primary metal industries	33	684,703	6,768	365	165	34	21	17	5
Fabricated metal products	34	1,450,089	36,314	606	192	34	18	10	

Industry	SIC code	Total Employees	Total Est.	Number of Establishments per Employee Size Range					
				250 to 499	500 to 999	1,000 to 1,499	1,500 to 2,499	2,500 to 4,999	5,000 or more
Industrial machinery & equipment	35	1,883,431	55,476	686	338	74	46	25	7
Electronic & other electronic equipment	36	1,503,923	17,058	775	373	101	67	37	12
Transportation equipment	37	1,543,731	11,256	463	255	75	62	67	51
Instrument & related products	38	832,706	11,378	361	177	55	33	23	10
Miscellaneous manufacturing	39	394,287	17,899	153	57	11	7	1	
Administrative & Auxiliary	-	1,326,527	12,105	560	315	104	64	32	12
TRANSPORTATION & PUBLIC UTILITIES									
Local & Interurban passenger transit	41	403,025	18,900	101	22	4	2	1	1
Trucking & Warehousing	42	1,808,949	124,190	306	150	30	12	56	12
Water transportation	44	164,920	8,707	45	31	13	2	1	
Transportation by Air	45	715,137	12,076	150	78	32	27	19	20
Pipelines, except natural gases	46	16,395	1,091	4	0	1			
Transportation services	47	391,340	50,172	50	17				
Communication	48	1,340,061	44,713	563	224	51	28	7	4
Electronic, gas, & sanitary services	49	908,820	22,455	340	152	57	35	11	4
Administrative & Auxiliary	-	175,605	2,682	57	30	6	3	4	5
WHOLESALE									
Wholesale trade-durable goods	50	3,683,301	327,640	488	135	19	13	1	
Wholesale trade-nondurable goods	51	2,582,397	184,384	550	146	39	15	13	
Administrative & Auxiliary	-	340,488	5,713	177	69	15	11	3	1
RETAIL TRADE									
Bldg. Materials & garden supplies	52	739,615	64,436	35	1				
General merchandise store	53	2,290,572	36,216	1,541	217	14	13	1	
Food stores	54	3,188,462	181,870	452	51	2			1
Auto dealers & service station	55	2,189,767	199,791	79	5			1	
Apparel & accessory stores	56	1,147,856	135,270	37	44	4			
Furniture & home furnishing stores	57	859,460	116,727	36	5	2			
Eating & drinking places	58	7,208,158	456,732	209	46	4	2		
Miscellaneous retail	59	2,610,918	360,787	110	53	16	8	7	
Administrative & Auxiliary	-	849,766	16,055	433	254	65	19	12	1

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Industry	SIC code	Total Employees	Total Est.	Number of Establishments per Employee Size Range					
				250 to 499	500 to 999	1,000 to 1,499	1,500 to 2,499	2,500 to 4,999	5,000 or more
FINANCE, INSURANCE, AND REAL ESTATE									
Depository Institution	60	2,079,264	104,666	491	223	68	48	13	5
Nondepository Institution	61	489,804	45,408	136	62	15	10	5	
Security & commodity brokers	62	522,895	40,961	115	63	14	9	5	
Insurance carriers	63	1,502,920	41,330	594	287	93	80	22	14
Insurance agents, brokers, & servicers	64	676,602	125,361	70	20	2	5		
Real Estate	65	1,402,828	246,119	212	64	8	1	1	
Holding & other investment offices	67	255,044	23,202	71	27	5	5	3	
Administrative & Auxiliary	-	68,799	1,452	50	18	3	2		
SERVICES									
Hotels & other lodging places	70	1,575,077	54,130	669	261	66	35	30	4
Personal services	72	1,281,898	202,349	156	12	3	2	1	
Business services	73	6,824,962	352,658	2,651	1,031	217	123	61	22
Auto repair, services, & parking	75	990,658	181,336	62	18	1			
Misc. repair services	76	456,425	73,562	33	5		2		
Motion picture	78	511,651	42,946	40	17	5	5	5	5
Amusement & recreation services	79	1,324,194	93,500	242	107	42	19	8	3
Health services	80	10,851,331	478,286	2,528	1,525	731	611	310	65
Legal services	81	960,693	163,554	167	49	2	1		
Educational services	82	2,066,531	46,224	521	323	140	80	37	33
Social services	83	2,263,314	155,846	475	97	12	6		
Museums, botanical, zoological gardens	84	76,079	3,790	40	7	1	1	1	
Membership organization	86	2,151,350	243,592	274	61	15	7	3	3
Engineering & management service	87	2,795,304	269,243	673	255	50	60	21	10
Service	89	100,472	14,877	14	6	1	1		
Administrative & Auxiliary	-	477,226	9,639	221	92	31	11	4	3
Unclassified	-	105,336	68,916	1					

Note: (D) Data withheld to avoid disclosing data for individual companies: data included in broader industry totals.

Source: US Bureau of Census, County Business Patterns 1995.

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Appendix B

Computer Use By Employees

SIC Category	Number of Survey Respondents Employed	Respondents Using a Computer at Work	Computer Use per Employee in 1993	Estimated Computer Use per Employee in 2001
All industries	118,400	51,106	0.43	0.56
Agriculture services	968	160	0.17	0.24
Other agriculture	2006	219	0.11	0.16
Mining	689	307	0.45	0.46
Construction	7,567	1,182	0.16	0.25
Lumber and wood	841	114	0.14	0.17
Furniture	665	161	0.24	0.30
Stone, clay	568	165	0.29	0.36
Primary metals	653	217	0.33	0.42
Fabricated metals	1,290	442	0.34	0.43
Machinery, excluding electric	2,238	1,233	0.55	0.69
Electrical machinery	1,689	950	0.56	0.70
Motor vehicles	1,120	428	0.38	0.48
Aircraft and parts	502	335	0.67	0.84
Other transportation	624	376	0.60	0.75
Professional photo equipment	680	406	0.60	0.75
Toys, sporting goods	128	44	0.34	0.43
Miscellaneous manufacturing	437	100	0.23	0.29
Food and kindred products	1,776	532	0.30	0.37
Tobacco manufacturing	52	25	0.48	0.60
Textile mill products	664	177	0.27	0.33
Apparel & other finished goods	970	143	0.15	0.18
Paper and allied products	740	339	0.46	0.57
Printing, publishing	1,705	857	0.50	0.63
Chemicals and allied products	1,220	729	0.60	0.75
Petroleum, coal	145	88	0.61	0.76
Rubber and plastics	791	293	0.37	0.46
Leather and leather products	107	24	0.22	0.28
Transportation	5,410	1,866	0.34	0.42
Communications	1,637	1,283	0.78	0.96
Utilities & sanitary	1,501	807	0.54	0.66
Wholesale trade	4,531	2,226	0.49	0.66
Retail trade	18,706	5,837	0.31	0.42
Banking and finance	3,417	2,888	0.85	0.99
Insurance & real estate	4,561	3,094	0.68	0.79
Private household services	1,099	16	0.01	0.02
Business services	5,038	2,646	0.53	0.75

SIC Category	Number of Survey Respondents Employed	Respondents Using a Computer at Work	Computer Use per Employee in 1993	Estimated Computer Use per Employee in 2001
Repair services	1,915	382	0.20	0.28
Personal services	3,220	662	0.21	0.29
Entertainment, recreation	1,735	538	0.31	0.44
Hospitals	5,182	3,105	0.60	0.85
Health services, excluding hospitals	5,377	1,963	0.37	0.52
Education services	9,845	5,066	0.51	0.73
Social services	2,721	753	0.28	0.39
Other professional	5,578	3,735	0.67	0.95
Forestry, fisheries	166	56	0.34	0.48
Justice, public order	2,179	1,324	0.61	0.69
Administration human resource	834	632	0.76	0.86
National security	802	597	0.74	0.85
Other public administration	2,112	1,584	0.75	0.85

Sources: 1993 Census Data, Table 7WK Uses of Computers at work, by Sex and Intermediate Industry, in "Computer Use in the United States: October 1993." and Table D Use of Computers at Work by People 18 Years and Older by Gender: October 1997, "Computer Use in the United States: October 1997."

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Appendix C

Disposal Cost Source Details

Disposal Option	Source	Source Cost per Ton	Year of cost estimate	Cost (Price Paid) per Ton (2001$)
Collectors				
	1	$ 240	1998	
	2	$ 400	2001	
	3	$ 0	2001	
	4	$ 383	1997	
Average		$ 250	1998	$ 271
Export				
	4	$ 100	1999	$ 107
Reuse				
	None	$ 0	2001	$ 0
Treatment and Subtitle C or D Landfill Disposal				
Whole CRTs	5	$ 1,196	1998	
	6	$1,300	2001	
	7	$ 1,500	2001	
Value used in analysis		$ 1,500	2001	$ 1,500
Crushed CRTs	7	$ 160	2001	
	8	$ 100	2000	
	9	$ 125	2000	
Value used in analysis		$ 160	2001	$ 160
Subtitle D Landfill Disposal				
	8	$ 40	2000	$ 41
Reclaimer				
	4	$ 667	1997	
	8	$ 200	2000	
	8	$ 420	2000	
	10	$ 200	1998	

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Disposal Option	Source	Source Cost per Ton	Year of cost estimate	Cost (Price Paid) per Ton (2001$)
	10	$ 350	1998	
	11	$ 140	1998	
	12	$ 200	1997	
	12	$ 500	1997	
	13	$ 200	1997	
	13	$ 300	1997	
	14	$ 200	1998	
Whole CRTs - Average		$ 284	2000	$ 295
Whole bare CRTs - Average		$ 200	2000	$ 207
Crushed CRTs - Average		$ 140	1998	$ 152
Glass Processor				
Broken CRTs with no metal	15,16	$ 0	2001	$ 0
Broken CRTs with metal		$ 100	2001	$ 100
Whole bare CRTs		$ 192	2001	$ 192
Broken mixed color and monochrome CRTs		$ 325	2001	$ 325
Whole CRTs		$ 333	2001	$ 333
CRT Glass Manufacturer				
	15	($ 175)	2001	($ 175)

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Source Number	Source Title
1	DMC Recycling Inc, 1998.
2	F&M Bay Electronics Co. Inc./SEER Inc., 2001.
3	WasteNot Recycling, 2001.
4	U.S. Environmental Protection Agency, Region 1. *Analysis of Five Community Consumer/Residential Collections, End-of-Life Electronic and Electrical Equipment.* EPA-901-R-98-003, April 1999.
5	Personal communications with Chem Waste Management, 1998.
6	Personal communications with Clean Harbors of Braintree, 2001.
7	Personal communications with Envirosafe Services of Ohio, 2001.
8	U.S. Environmental Protection Agency, Office of Solid Waste, Economics, Methods and Risk Analysis Division. *Unit Cost Compendium*. September 30, 2000.
9	ETC's landfill cost survey, 2000.
10	Personal communications with Noranda, 1998.
11	Personal communications with Doe Run, 1998.
12	Aanstoos, T., Mizuki, C., Nichols, S., and Pitts, G. *CRT Disposition: An Assessment of Limitations and Opportunities in Reuses, Refurbishment, and Recycling in the U.S.,* IEEE International Symposium on Electronics & the Environment, 1997.
13	Cutter Information Corp.'s "Product Stewardship Advisor" Vol. I, No. 4, 1997.
14	National Safety Council, *Electronic Product Recovery and Recycling Baseline Report, Recycling of Selected Electronic Products in the United States.* May 1999.
15	Personal communications with Greg Voorhees of Envirocycle, 2001.
16	Price list from Envirocycle, 2001.

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Appendix D

Flow of CRTs under Subtitle C (Number)

	Total Number of CRTs	To Collector	To Reuse	To MSW Landfill (Subtitle D)	To HW Landfill (Subtitle C)	To Reclaimer	To Glass Processor	To Exporter	To CRT Manufacturer
Baseline									
Original Users									
SQGs CRT only	2,036,512	1,547,749	40,730		40,730	305,477	101,826		
SQGs all HW	105,753	79,315			26,438				
LQGs CRT only	453,584	344,724	9,072		9,072	68,038	22,679		
LQGs all HW	45,517	34,138			11,379				
Collectors									
SQGs	167,160		33,432		3,343	38,447	41,790	50,148	
LQGs	1,838,765		367,753		183,877	183,877	551,630	551,630	
Glass Processor									
Funnel glass	245,826					4,917			240,910
Panel glass	472,098					9,442			462,656
All CRTs		2,005,925	450,987	0	274,839	610,196	717,924	601,778	703,566
Primary Alternative									
Original Users									
SQGs CRT only	40,727				40,727				
SQGs all HW	2,129				2,129				
LQGs CRT only	8,919				8,919				
LQGs all HW	920				920				
Former SQG - CRT only	1,995,785	1,556,712	39,916			299,368	99,789		
Former SQG - all HW	103,624	80,827	2,072			15,544	5,181		

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	Total Number of CRTs	To Collector	To Reuse	To MSW Landfill (Subtitle D)	To HW Landfill (Subtitle C)	To Reclaimer	To Glass Processor	To Exporter	To CRT Manufacturer
Former LQG - CRT only	444,665	346,839	8,893			66,700	22,233		
Former LQG - all HW	44,597	34,786	892			6,690	2,230		
Collectors									
SQGs	3,365		673		67	774	841	1,010	
LQGs	37,018		7,404		740	5,553	16,658	6,663	
Former SQG	164,898		32,980			41,225	41,225	49,470	
Former LQG	1,813,882		362,776			308,360	816,247	326,499	
Glass Processor									
Funnel glass	343,921					6,878			337,042
Panel glass	660,484					13,210			647,274
All CRTs		2,019,164	455,606	0	53,502	764,300	1,004,405	383,641	984,317
CSI Alternative									
Original Users									
SQGs CRT only	305,535				45,830	259,705			
SQGs all HW	15,843				2,376	13,467			
LQGs CRT only	67,528				10,129	57,399			
LQGs all HW	6,845				1,027	5,819			
Collectors									
SQGs	164,678		32,936		3,294	37,876	41,170	49,404	
LQGs	1,811,462		362,292		36,229	235,490	815,158	362,292	
Glass Processor									
Funnel glass	370,110					7,402			362,708
Panel glass	710,779					14,216			696,563
CSI Handlers									
CSI SQHs	2,245,614	1,976,140	44,912				224,561		

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	Total Number of CRTs	To Collector	To Reuse	To MSW Landfill (Subtitle D)	To HW Landfill (Subtitle C)	To Reclaimer	To Glass Processor	To Exporter	To CRT Manufacturer
CSQ LQHs									
All CRTs		1,976,140	440,140	0	98,886	631,373	1,080,889	411,696	1,059,271

Flow of CRTs under Subtitle C (Tons)

	Total Tons of CRTs	To Collector	To Reuse	To MSW Landfill (Subtitle D)	To HW Landfill (Subtitle C)	To Reclaimer	To Glass Processor	To Exporter	To CRT Manufacturer
Baseline									
Original Users									
SQGs CRT only	35,639	27,086	713		713	5,346	1,782		
SQGs all HW	1,851	1,388			463				
LQGs CRT only	7,938	6,033	159		159	1,191	397		
LQGs all HW	797	597			199				
Collectors									
SQGs	2,925		585		**35**	**404**	**439**	878	
LQGs	32,178		6,436		**1,931**	**1,931**	**5,792**	9,654	
Glass Processor									
Funnel glass	2,581					**52**			**2,530**
Panel glass	4,957					**99**			**4,858**
All CRTs		35,104	7,892		3,499	9,022	**7,538**	10,531	**7,387**
Primary Alternative									
Original Users									
SQGs CRT only	713				713				
SQGs all HW	37				37				
LQGs CRT only	156				156				
LQGs all HW	16				16				

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	Total Tons of CRTs	To Collector	To Reuse	To MSW Landfill (Subtitle D)	To HW Landfill (Subtitle C)	To Reclaimer	To Glass Processor	To Exporter	To CRT Manufacturer
Former SQG - CRT only	34,926	27,242	699			5,239	1,746		
Former SQG - all HW	1,813	1,414	36			272	91		
Former LQG - CRT only	7,782	6,070	156			1,167	389		
Former LQG - all HW	780	609	16			117	39		
Collectors									
SQHs	59		12		**1**	**8**	**9**	18	
LQHs	648		130		**8**	**58**	**175**	117	
Former SQH	2,886		577			**433**	**433**	866	
Former LQH	31,743		6,349			**3,238**	**8,571**	5,714	
Glass Processor									
Funnel glass	3,611					**72**			**3,539**
Panel glass	6,935					**139**			**6,796**
All CRTs		35,335	7,973		931	10,743	**10,546**	6,714	**10,335**
CSI Alternative									
Original Users									
SQGs CRT only	5,347				802	4,545			
SQGs all HW	277				42	236			
LQGs CRT only	1,182				177	1,004			
LQGs all HW	120				18	102			
Collectors									
SQHs	2,882		576		**35**	**398**	**432**	865	
LQHs	31,701		6,340		**380**	**2,473**	**8,559**	6,340	
Glass Processor									

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	Total Tons of CRTs	To Collector	To Reuse	To MSW Landfill (Subtitle D)	To HW Landfill (Subtitle C)	To Reclaimer	To Glass Processor	To Exporter	To CRT Manufacturer
Funnel glass	3,886					**78**			**3,808**
Panel glass	7,463					**149**			**7,314**
CSI Handlers									
CSI SQHs	39,298	34,582	786				3,930		
CSQ LQHs									
All CRTs		34,582	7,702	0	1,454	8,984	**11,349**	7,205	**11,122**

Bolded entries include the weight of the CRT glass only. Non-bolded entries include the weight of the entire monitor.

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Flow of CRTs under Subtitle D (Number)

	Total Number of CRTs	To Collector	To Reuse	To MSW Landfill (Subtitle D)	To HW Landfill (Subtitle C)	To Reclaimer	To Glass Processor	To Exporter	To CRT Manufacturer
Baseline									
Original Users									
SQGs CRT only	2,036,512	122,191	40,730	1,629,210	40,730	101,826	101,826		
SQGs all HW	105,753	10,575		84,602	10,575				
LQGs CRT only	453,584	27,215	9,072	362,867	9,072	22,679	22,679		
LQGs all HW	45,517	4,552		36,414	4,552				
Collectors									
SQGs	13,711		2,742	6,856		686	686	2,742	
LQGs	150,822		30,164	64,853	3,016	7,541	15,082	30,164	
Glass Processor									
Funnel glass	48,031					961			47,070
Panel glass	92,241					1,845			90,397
All CRTs		164,533	82,708	2,184,802	67,945	135,537	140,273	32,907	137,467
PrimaryAlternative									
Original Users									
SQGs CRT only	40,727				40,727				
SQGs all HW	2,129				2,129				
LQGs CRT only	8,919				8,919				
LQGs all HW	920				920				
Former SQG - CRT only	1,995,785	199,579	39,916	1,496,839		139,705	119,747		
Former SQG -HW	103,624	10,362	2,072	77,718		7,254	6,217		
Former LQG-CRT only	444,665	44,467	8,893	333,499		31,127	26,680		

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	Total Number of CRTs	To Collector	To Reuse	To MSW Landfill (Subtitle D)	To HW Landfill (Subtitle C)	To Reclaimer	To Glass Processor	To Exporter	To CRT Manufacturer
Former LQG -HW	44,597	4,460	892	33,448		3,122	2,676		
Collectors									
SQGs	431		86	173	9	56	43	65	
LQGs	4,746		949	1,898	95	380	712	712	
Former SQG	21,141		4,228	8,456		3,171	2,114	3,171	
Former LQG	232,549		46,510	93,020		23,255	34,882	34,882	
Glass Processor									
Funnel glass	66,110					1,322			64,788
Panel glass	126,962					2,539			124,422
All CRTs		39,031	17,564	405,924	9,793	29,046	30,086	5,855	29,485
CSIAlternative									
Original Users									
SQGs CRT only	305,535			183,321	45,830	76,384			
SQGs all HW	15,843			9,506	2,376	3,961			
LQGs CRT only	67,528			40,517	10,129	16,882			
LQGs all HW	6,845			4,107	1,027	1,711			
Collectors									
SQGs	18,713		3,743	7,111	374	1,871	1,871	3,743	
LQGs	205,848		41,170	78,222	4,117	10,292	30,877	41,170	
Glass Processor									
Funnel glass	88,106					1,762			86,344
Panel glass	169,204					3,384			165,820
CSI Handlers									
CSI SQHs	2,245,614	224,561	44,912	1,751,579			224,561		
CSI LQHs									
All CRTs		258,867	103,547	2,045,051	52,798	211,930	193,072	38,830	189,210

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Flow of CRTs under Subtitle D (Tons)

	Total Tons of CRTs	To Collector	To Reuse	To MSW Landfill (Subtitle D)	To HW Landfill (Subtitle C)	To Reclaimer	To Glass Processor	To Exporter	To CRT Manufacturer
Baseline									
Original Users									
SQGs CRT only	35,639	2,138	713	28,511	713	1,782	1,782		
SQGs all HW	1,851	185		1,481	185				
LQGs CRT only	7,938	476	159	6,350	159	397	397		
LQGs all HW	797	80		637	80				
Collectors									
SQGs	240		48	120	**0**	**7**	**7**	48	
LQGs	2,639		528	1,135	**32**	**79**	**158**	528	
Glass Processor									
Funnel glass	504					**10**			**494**
Panel glass	969					**19**			**949**
All CRTs		2,879	1,447	38,234	1,168	2,295	**1,473**	576	**1,443**
PrimaryAlternative									
Original Users									
SQGs CRT only	713				713				
SQGs all HW	37				37				
LQGs CRT only	156				156				
LQGs all HW	16				16				
Former SQG - CRT only	34,926	3,493	699	26,195		2,445	2,096		
Former SQG - HW	1,813	181	36	1,360		127	109		
Former LQG- CRT only	7,782	778	156	5,836		545	467		
Former LQG - HW	780	78	16	585		55	47		

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	Total Tons of CRTs	To Collector	To Reuse	To MSW Landfill (Subtitle D)	To HW Landfill (Subtitle C)	To Reclaimer	To Glass Processor	To Exporter	To CRT Manufacturer
Collectors									
SQHs	8		2	3	**0**	**1**	**0**	1	
LQHs	83		17	33	**1**	**4**	**7**	12	
Former SQH	370		74	148		**33**	**22**	55	
Former LQH	4,070		814	1,628		**244**	**366**	610	
Glass Processor									
Funnel glass	694					**14**			**680**
Panel glass	1,333					**27**			**1,306**
All CRTs		4,530	1,812	35,788	923	3,494	**2,027**	680	**1,987**
CSI Alternative									
Original User									
SQGs CRT only	5,347			3,208	802	1,337			
SQGs all HW	277			166	42	69			
LQGs CRT only	1,182			709	177	295			
LQGs all HW	120			72	18	30			
Collectors									
SQGs	327		65	124	**4**	**20**	**20**	65	
LQGs	3,602		720	1,369	**43**	**108**	**324**	720	
Glass Processor									
Funnel glass	925					**19**			**907**
Panel glass	1,777					**36**			**1,741**
CSI Handlers									
CSI SQHs	39,298	3,930	786	30,653			3,930		
CSI LQHs									
All CRTs		3,930	1,572	36,301	1,086	1,913	**2,702**	786	**2,648**

Bolded entries include the weight of the CRT glass only. Non-bolded entries include the weight of the entire monitor.

Appendix E

Average Shipment Sizes for Each Type of Establishment Distributing CRTs to Each CRT Management Option

	To Collector	To Reuse	To HW (Subtitle C)	To Reclaimer	To Glass Processor	To Exporter	To CRT Manufacturer
Baseline - Subtitle C							
SQGs CRT only	1.4	1.4	1.4	1.4	1.4		
SQGs all HW	0.4	-	0.4	-	-		
LQGs CRT only	5.2	5.1	5.1	5.2	5.1		
LQGs all HW	0.2	-	0.2	-	-		
SQHs		11.8	7.1	7.4	7.4	11.8	
LQHs		13.0	8.1	8.1	8.1	13.0	
Glass Processor - Funnel				9.3			13.2
Glass Processor - Panel				13.4			13.6
Primary Alternative - Subtitle C							
SQGs CRT only	-	-	1.4	-	-		
SQGs all HW	-	-	0.4	-	-		
LQGs CRT only	-	-	5.2	-	-		
LQGs all HW	-	-	0.2	-	-		
SQHs		9.5	0.6	6.6	7.1	7.1	
LQHs		13.1	6.3	7.8	7.8	11.8	
Glass Processor - Funnel				12.7			13.5
Glass Processor - Panel				12.2			13.8
Former SQG - CRT only PA	2.8	2.8	-	2.8	2.8		
Former SQG - HW PA	0.8	0.8	-	0.8	0.8		
Former LQG - CRT only PA	20.7	19.8	-	20.7	19.8		
Former LQG - HW PA	0.8	0.7	-	0.8	0.8		
Former SQH		11.6	-	7.4	7.4	11.8	
Former LQH		21.9	-	13.7	13.8	21.9	
CSI Alternative - Subtitle C							
SQGs CRT only	-	-	1.4	1.4	-		
SQGs all HW	-	-	0.4	0.4	-		
LQGs CRT only	-	-	-	-	-		
LQGs all HW	-	-	0.6	0.6	-		
SQHs		11.6	7.0	7.3	7.3	11.6	
LQHs		12.8	7.9	8.0	8.0	12.8	
Glass Processor - Funnel				13.2			13.6
Glass Processor - Panel				12.7			13.6
CSI SQHs	-	-	-	-	-		
CSI LQHs	-	-	-	-	-		

Number of Shipments each Year Under Subtitle C

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	Collectors	Reuse	Subtitle C Disposal	Reclaimers	Glass Processors	Exporters	CRT Glass Manufacturers	Totals
Baseline								
Original Users								
SQGs CRT only	15,526	409	409	3,065	1,022			20,431
SQGs all HW	3,342		1,114					4,456
LQGs CRT only	888	24	24	176	59			1,171
LQGs all HW	2,763		921					3,684
Collectors								
SQGs		40	4	44	48	60		196
LQGs		400	192	192	574	600		1,958
Glass Processors								
Funnel glass				2			94	96
Panel glass				4			172	176
Primary Alternative								
Original Users								
SQGs CRT only			408					408
SQGs all HW			90					90
LQGs CRT only			24					24
LQGs all HW			72					72
Former SQG - CRT only	15,616	401		3,003	1,001			20,021
Former SQG -all HW	1,703	44		328	110			2,185
Former LQG - CRT only	2,454	63		472	158			3,147
Former LQG -all HW	705	19		136	46			906
Collectors								
SQGs		1	1	1	1	2		6
LQGs		8	1	6	18	8		41
Former SQGs		40		47	47	59		193
Former LQGs		294		211	633	294		1,432
Glass Processors								
Funnel glass				3			128	131
Panel glass				5			241	246
CSI Alternative								

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	Collectors	Reuse	Subtitle C Disposal	Reclaimers	Glass Processors	Exporters	CRT Glass Manufacturers	Totals
Original Users								
SQGs CRT only			460	2,605				3,065
SQGs all HW			101	568				669
LQGs CRT only			27	150				177
LQGs all HW			83	470				553
Collectors								
SQHs		40	4	44	48	60		196
LQHs		400	39	287	861	360		1,947
Glass Processors								
Funnel glass				3			138	141
Panel glass				6			260	266
CSI Handlers								
CSI SQHs	30,643	697			3,483			34,823
CSI LQHs								

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Appendix F

Average Annual Sales per Establishment by 2-Digit SIC Code

Industry	SIC Code	Average Sales per Establishment ($)
AGRICULTURE		
Agricultural services	7	$ -
Forestry	8	$ -
Fishing, hunting, trapping	9	$ -
Administrative & Auxiliary	-	
MINING		
Metal Mining	10	$ 9,642,717
Coal Mining	12	$ 8,841,349
Oil & Gas Extraction	13	$ 5,338,313
Non-metallic minerals, except fuels	14	$ 2,338,749
Administrative & Auxiliary	-	$ 1,545,768
CONSTRUCTION		
General contractors	15	$ 1,280,404
Heavy construction	16	$ 2,570,507
Special trade contractors	17	$ 590,600
Administrative & Auxiliary	-	$ 2,207,600
MANUFACTURING		
Food & kindred products	20	$ 19,567,362
Tobacco products	21	$ 308,752,632
Textile mill products	22	$ 12,020,557
Apparel & other textile products	23	$ 3,103,014
Lumber & wood products	24	$ 2,277,901
Furniture & Fixtures	25	$ 3,759,298
Paper & allied products	26	$ 20,760,708
Printing & publishing	27	$ 2,540,878
Chemicals & allied products	28	$ 25,443,194
Petroleum and coal products	29	$ 70,728,296
Rubber & miscellaneous plastics products	30	$ 7,170,357
Leather & leather products	31	$ 4,751,863
Stone, clay, and glass products	32	$ 3,846,475
Primary metal industries	33	$ 21,271,651
Fabricated metal products	34	$ 4,571,413
Industrial machinery & equipment	35	$ 4,793,932
Electronic & other electronic equipment	36	$ 12,809,615

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Industry	SIC Code	Average Sales per Establishment ($)
Transportation equipment	37	$ 35,374,262
Instrument & related products	38	$ 11,884,834
Miscellaneous manufacturing	39	$ 2,318,656
Administrative & Auxiliary	-	$ 3,156,356
TRANSPORTATION		
Local & Interurban passenger transit	41	$ 710,436
Trucking & Warehousing	42	$ 1,296,519
Water transportation	44	$ 3,585,027
Transportation by Air	45	$ 2,338,134
Pipelines, except natural gases	46	$ 8,368,550
Transportation services	47	$ 512,735
Communication	48	$ 5,877,769
Electronic, gas, & sanitary services	49	$ 15,510,062
Administrative & Auxiliary	-	$ 1,766,775
WHOLESALE TRADE		
Wholesale trade-durable goods	50	$ 5,084,711
Wholesale trade-nondurable goods	51	$ 9,036,867
Administrative & Auxiliary	-	$ 781,548
RETAIL TRADE		
Bldg. Materials & garden supplies	52	$ 1,422,393
General merchandise store	53	$ 7,089,224
Food stores	54	$ 2,044,651
Auto dealers & service station	55	$ 4,100,193
Apparel & accessory stores	56	$ 699,117
Furniture & home furnishing stores	57	$ 846,766
Eating & drinking places	58	$ 450,446
Miscellaneous retail	59	$ 607,995
Administrative & Auxiliary	-	$ 370,918
FINANCE, INSURANCE, AND REAL ESTATE		
Depository Institution	60	$ 5,091,211
Nondepository Institution	61	$ 3,432,819
Security & commodity brokers	62	$ 3,491,738
Insurance carriers	63	$ 20,422,940
Insurance agents, brokers, & servicers	64	$ 424,989
Real Estate	65	$ 617,331
Holding & other investment offices	67	$ 3,237,932
Administrative & Auxiliary	-	$ 1,054,687

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Industry	SIC Code	Average Sales per Establishment ($)
SERVICES		
Hotels & other lodging places	70	$ 1,423,393
Personal services	72	$ 219,582
Business services	73	$ 896,726
Auto repair, services, & parking	75	$ 407,237
Misc. repair services	76	$ 429,359
Motion picture	78	$ 1,040,439
Amusement & recreation services	79	$ 793,715
Health services	80	$ 677,073
Legal services	81	$ 641,030
Educational services	82	$ 491,509
Social services	83	$ 225,786
Museums, botanical, zoological gardens	84	$ 611,305
Membership organization	86	$ 500,857
Engineering & management service	87	$ 827,956
Services, n.e.c	89	$ 546,119
Administrative & Auxiliary	-	$ 1,053,680
Unclassified	-	NA

Source: U.S. Bureau of the Census (1992). Includes County Business Patterns data and data from the Enterprise Statistics Program.

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Appendix G

Detailed Sensitivity Analysis Results on All Parameters Tested

Parameter Names	Sensitivity Test Parameter Values	Percent Change from Best Estimate	Savings Under Primary Alternative	Savings Under Primary Alternative Using the Sensitivity Test Parameter Values	Percent increase (decrease) in amount saved	Savings Under CSI Alternative	Savings Under CSI Alternative Using the Sensitivity Test Parameter Values	Percent increase (decrease) in amount saved
Entry/exit rate for establishments								
Best Estimate	1 %							
Low Range	0.10 %	-90 %	$ 4,840,000	$ 4,811,000	-1 %	$ 3,098,000	$ 3,095,000	0 %
High Range	5 %	400 %	$ 4,840,000	$ 4,962,000	3 %	$ 3,098,000	$ 3,109,000	0 %
Percent laptops disposed								
Best Estimate	18 %							
Low Range	10 %	-44 %	$ 4,840,000	$ 4,830,000	0 %	$ 3,098,000	$ 3,127,000	1 %
High Range	33 %	83 %	$ 4,840,000	$ 4,132,000	-15 %	$ 3,098,000	$ 2,582,000	-17 %
Percent funnel glass (vs panel glass)								
Best Estimate	34 %							
Low Range	30 %	-12 %	$ 4,840,000	$ 4,840,000	0 %	$ 3,098,000	$ 3,098,000	0 %
High Range	40 %	18 %	$ 4,840,000	$ 4,840,000	0 %	$ 3,098,000	$ 3,098,000	0 %
Percent of shipments that include broken CRTs								
Best Estimate	100 %							
Low Range	25 %	-75 %	$ 4,840,000	$ 4,754,000	-2 %	$ 3,098,000	$ 3,005,000	-3 %
High Range	100 %	0 %	$ 4,840,000	$ 4,840,000	0 %	$ 3,098,000	$ 3,098,000	0 %
Percent of CRTs sent to SQ Collectors								
Best Estimate	8 %							
Low Range	2 %	-75 %	$ 4,840,000	$ 4,812,000	-1 %	$ 3,098,000	$ 3,152,000	2 %
High Range	50 %	525 %	$ 4,840,000	$ 5,002,000	3 %	$ 3,098,000	$ 2,850,000	-8 %
Percent of CRTs sent to former SQ Collectors (Primary Alternative only)								
Best Estimate	98 %							
Low Range	50 %	-49 %	$ 4,840,000	$ 4,347,000	-10 %	N/A	N/A	N/A
High Range	99 %	1 %	$ 4,840,000	$ 4,849,000	0 %	N/A	N/A	N/A
Percent of generators sending to reuse								

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Parameter Names	Sensitivity Test Parameter Values	Percent Change from Best Estimate	Savings Under Primary Alternative	Savings Under Primary Alternative Using the Sensitivity Test Parameter Values	Percent increase (decrease) in amount saved	Savings Under CSI Alternative	Savings Under CSI Alternative Using the Sensitivity Test Parameter Values	Percent increase (decrease) in amount saved
Best Estimate	2 %							
Low Range	0 %	-100 %	$ 4,840,000	$ 4,767,000	-2 %	$ 3,098,000	$ 3,195,000	3 %
High Range	15 %	650 %	$ 4,840,000	$ 4,893,000	1 %	$ 3,098,000	$ 2,851,000	-8 %
Percent of CRTs sent for export (Baseline only)								
Best Estimate	30 %							
Low Range	10 %	-67 %	$ 4,840,000	$ 4,630,000	-4 %	$ 3,098,000	$ 2,888,000	-7 %
High Range	50 %	67 %	$ 4,840,000	$ 4,764,000	-2 %	$ 3,098,000	$ 3,022,000	-2 %
Percent of CRTs sent for export (Primary Alternative only)								
Best Estimate	30 % or 18 %							
Low Range	5 %	-83 % or -72 %	$ 4,840,000	$ 5,244,000	8 %	N/A	N/A	N/A
High Range	30 %	0 % or 66 %	$ 4,840,000	$ 4,523,000	-7 %	N/A	N/A	N/A
Percent of CRTs sent for export (CSI Alternative only)								
Best Estimate	30 % or 20 %							
Low Range	5 %	0 % or -75 %	N/A	N/A	N/A	$ 3,098,000	$ 3,487,000	13 %
High Range	40 %	33 % or 100 %	N/A	N/A	N/A	$ 3,098,000	$ 2,627,000	-15 %
Maximum shipment weight (in tons) for whole CRTs								
Best Estimate	22							
Low Range	18	-18 %	$ 4,840,000	$ 4,670,000	-4 %	$ 3,098,000	$ 3,085,000	0 %
High Range	24	9 %	$ 4,840,000	$ 4,897,000	1 %	$ 3,098,000	$ 3,104,000	0 %
Maximum shipment weight (in tons) for crushed CRTs								
Best Estimate	23							
Low Range	20	-13 %	$ 4,840,000	$ 4,932,000	2 %	$ 3,098,000	$ 3,104,000	0 %
High Range	25	9 %	$ 4,840,000	$ 4,788,000	-1 %	$ 3,098,000	$ 3,091,000	0 %
Shipping Distances (in miles):								
to Handler								
Best Estimate	20							
Low Range	5	-75 %	$ 4,840,000	$ 4,840,000	0 %	$ 3,098,000	$ 3,096,000	0 %
High Range	50	150 %	$ 4,840,000	$ 4,838,000	0 %	$ 3,098,000	$ 3,100,000	0 %
to Reuse								
Best Estimate	20							

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Parameter Names	Sensitivity Test Parameter Values	Percent Change from Best Estimate	Savings Under Primary Alternative	Savings Under Primary Alternative Using the Sensitivity Test Parameter Values	Percent increase (decrease) in amount saved	Savings Under CSI Alternative	Savings Under CSI Alternative Using the Sensitivity Test Parameter Values	Percent increase (decrease) in amount saved
Low Range	5	-75 %	$ 4,840,000	$ 4,840,000	0 %	$ 3,098,000	$ 3,097,000	0 %
High Range	50	150 %	$ 4,840,000	$ 4,839,000	0 %	$ 3,098,000	$ 3,099,000	0 %
to Subtitle C Landfill								
Best Estimate	250							
Low Range	100	-60 %	$ 4,840,000	$ 4,738,000	-2 %	$ 3,098,000	$ 3,018,000	-3 %
High Range	500	100 %	$ 4,840,000	$ 5,008,000	3 %	$ 3,098,000	$ 3,230,000	4 %
to Glass Processor								
Best Estimate	200							
Low Range	100	-50 %	$ 4,840,000	$ 4,767,000	-2 %	$ 3,098,000	$ 3,137,000	1 %
High Range	400	100 %	$ 4,840,000	$ 4,984,000	3 %	$ 3,098,000	$ 3,017,000	-3 %
to CRT Glass Manufacturer								
Best Estimate	100							
Low Range	50	-50 %	$ 4,840,000	$ 4,844,000	0 %	$ 3,098,000	$ 3,104,000	0 %
High Range	200	100 %	$ 4,840,000	$ 4,829,000	0 %	$ 3,098,000	$ 3,085,000	0 %
to Reclaimer (from Generator or Collectors)								
Best Estimate	300							
Low Range	100	-67 %	$ 4,840,000	$ 4,744,000	-2 %	$ 3,098,000	$ 3,116,000	1 %
High Range	500	67 %	$ 4,840,000	$ 4,935,000	2 %	$ 3,098,000	$ 3,080,000	-1 %
to Reclaimer (from Glass Processors)								
Best Estimate	350							
Low Range	200	-43 %	$ 4,840,000	$ 4,839,000	0 %	$ 3,098,000	$ 3,099,000	0 %
High Range	500	43 %	$ 4,840,000	$ 4,839,000	0 %	$ 3,098,000	$ 3,096,000	0 %
Costs for Disposal to Glass Processor (per ton):								
Broken CRTs, no metal								
Best Estimate	$ 0							
Low Range	$ 0	N/A	$ 4,840,000	$ 4,840,000	0 %	$ 3,098,000	$ 3,098,000	0 %
High Range	$ 10.00	N/A	$ 4,840,000	$ 4,820,000	0 %	$ 3,098,000	$ 3,136,000	1 %
Broken CRTs, with metal								
Best Estimate	$ 100.00							
Low Range	$ 50.00	-50 %	$ 4,840,000	$ 4,859,000	0 %	$ 3,098,000	$ 3,115,000	1 %

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Parameter Names	Sensitivity Test Parameter Values	Percent Change from Best Estimate	Savings Under Primary Alternative	Savings Under Primary Alternative Using the Sensitivity Test Parameter Values	Percent increase (decrease) in amount saved	Savings Under CSI Alternative	Savings Under CSI Alternative Using the Sensitivity Test Parameter Values	Percent increase (decrease) in amount saved
High Range	$ 150.00	50 %	$ 4,840,000	$ 4,818,000	0 %	$ 3,098,000	$ 3,077,000	-1 %
Whole Bare CRTs								
Best Estimate	$ 192.00							
Low Range	$ 100.00	-48 %	$ 4,840,000	$ 4,859,000	0 %	$ 3,098,000	$ 3,115,000	1 %
High Range	$ 300.00	56 %	$ 4,840,000	$ 4,814,000	-1 %	$ 3,098,000	$ 3,073,000	-1 %
Broken mixed color/monochrome								
Best Estimate	$ 325.00							
Low Range	$ 250.00	-23 %	$ 4,840,000	$ 4,868,000	1 %	$ 3,098,000	$ 3,124,000	1 %
High Range	$ 400.00	23 %	$ 4,840,000	$ 4,808,000	-1 %	$ 3,098,000	$ 3,067,000	-1 %
Whole CRTs with casing								
Best Estimate	$ 333.33							
Low Range	$ 200.00	-40 %	$ 4,840,000	$ 4,853,000	0 %	$ 3,098,000	$ 3,332,000	8 %
High Range	$ 450.00	35 %	$ 4,840,000	$ 4,825,000	0 %	$ 3,098,000	$ 2,889,000	-7 %
Exporter, Disposal								
Best Estimate	$ 107.00							
Low Range	$ 0	-100 %	$ 4,840,000	$ 4,431,000	-8 %	$ 3,098,000	$ 2,741,000	-12 %
High Range	$ 200.00	87 %	$ 4,840,000	$ 5,195,000	7 %	$ 3,098,000	$ 3,407,000	10 %
CRT Glass Manufacturer, Disposal								
Best Estimate	$ (175.00)							
Low Range	$ (250.00)	43 %	$ 4,840,000	$ 4,914,000	2 %	$ 3,098,000	$ 3,191,000	3 %
High Range	$ 0	-100 %	$ 4,840,000	$ 4,661,000	-4 %	$ 3,098,000	$ 2,871,000	-7 %
Number of TVs from unregulated users								
Best Estimate	20,000,000							
LowRange	15,000,000	-25 %	$ 1,117,000	$ 1,660,000	49 %	$ 4,202,000	$ 4,024,000	-4 %
High Range	30,000,000	50 %	$ 1,117,000	$ (10,000)	-101 %	$ 4,202,000	$ 4,552,000	8 %
Number of monitors from unregulated users								
Best Estimate	16,886,411							
Low Range	10,000,000	-41 %	$ 1,117,000	$ 1,621,000	45 %	$ 4,202,000	$ 4,033,000	-4 %
High Range	25,000,000	48 %	$ 1,117,000	$ 434,000	-61 %	$ 4,202,000	$ 4,402,000	5 %

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Appendix H

Telephone Contacts

Contacts made by Sue Chotikajan:

Tony Catareno, I.G. Inc., 3476 Saint Rocco CT., Cleveland, OH 44109, (216) 631 -7710. November 6, 1998.

Questions:

(1) Where do you get your discarded CRTs?
(2) What types of industries/manufacturers are your sources (TV and computer manufacturers or post-consumer)?
(3) How much do you charge for taking discarded CRTs (Specifically for a 30 pound monitor)?
(4) What do you with the glass? Is it landfilled, sent to smelters, or sent to CRT glass manufacturers?
(5) What is the percentage of this allocation?
(6) What is the cost of sending glass to each disposal or recycling alternative?
(7) What is the total number of CRTs processed annually and total weight processed?
(8) Do you have information on the number of color vs. monochrome monitors processed?

Responses:

- I.G. Inc. receives used CRTs from leasing companies, a few from households, but none from manufacturers.

- I.G. Inc. charges $3-$5 per monitor for pick-up services of discarded computers, and leasing companies pay for their own transportation.

- CRTs are pulled out of monitor and processed. Some parts (phosphorous, metals, glass) are sent to recycling companies and glass manufacturers.

- All CRT glass is sent to CRT glass manufacturers.

- Information on cost sent to each glass manufacturers isn't shared with the public.

- The total number of CRTs processed annually is approximately 5,000 monitors.
- Since I.G., Inc. is only processing CRTs as a sideline, we do not track down the types of monitors processed.

Jim Weber, Federal Prison Industries, Ohio, (330) 424 –7448 (ext. 1313). November 6, 1998.

Questions:

(1) Where do you get your discarded CRTs?
(2) What types of industries/manufacturers are your sources (TV and computer manufacturers or post-consumer)?
(3) How much do you charge for taking discarded CRTs (Specifically for a 30 pound monitor)?
(4) What do you with the glass? Is it landfilled, sent to smelters, or sent to CRT glass manufacturers?
(5) What is the percentage of this allocation?
(6) What is the cost of sending glass to each disposal or recycling alternative?
(7) What is the total number of CRTs processed annually and total weight processed?
(8) Do you have information on the number of color vs. monochrome monitors processed?

Responses:

- Federal Prison Industries receives discarded computers from GE, Motorola, computer manufacturers, and schools. Federal Prison Industries doesn't receive any discarded televisions.

- Federal Prison Industries charges $4-$5 per monitor, and the manufacturer or entity discarding the computer monitors pays for the shipping.

- Generally, Federal Prison Industries' picks up and sorts the computer monitors and then sends them to Envirocycle, a CRT glass-to-glass recycling center. None of the discarded CRTs are landfilled or sent to smelters.

- All discarded CRTs are sent to CRT glass manufacturers, through CRT glass-to-glass recyclers, such as Envirocycle.

- Envirocycle pays $0.25 per pound of glass or $500 per ton of glass.

- Federal Prison Industries processes around 4,000 monitors per year.

- On average, they process an equal number of color and monochrome monitors. The most common types of color monitors discarded are GEA and CEA. They separate the glass into four types: PB, color, NPHS, and miscellaneous plastic filament.

Gary DiRusso, DMC Recycling, New Hampshire, gdirusso@dmcrecycling.com. October 30, 1998.

Questions:

(1) Where do you get your discarded CRTs?

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(2) What types of industries/manufacturers are your sources (TV and computer manufacturers or post-consumer)?
(3) How much do you charge for taking discarded CRTs (Specifically for a 30 pound monitor)?
(4) What do you with the glass? Is it landfilled, sent to smelters, or sent to CRT glass manufacturers?
(5) What is the percentage of this allocation?
(6) What is the cost sent to each?
(7) What is the total number of CRTs processed annually and total weight processed?
(8) Do you have information on the number of color vs. monochrome monitors processed?

Responses:

- DMC receives monitors from a government agency (NSA), businesses such as (SunMicro, AT&T, etc) and computer monitor manufacturers, such as Nissei, Sangyo (Hitachi).

- Approximately 50 percent by weight of the monitors that DMC receives from the government can be reused; the other 50 percent is disassembled and recycled. Reusable computer monitors represent approximately 30 percent of the total materials received from the government. The remaining 70 percent is computers, telecommunications equipment, and other electronic equipment.

- DMC charges $0.11 – 0.13 per pound (based on quantity) for recycling monitors.

- DMC receives shipments of 10,000 to 30,000 pounds at a time from monitor manufacturers.

- DMC currently processes approximately 1 million pounds of monitors per year with expectations that this could increase considerably because of the landfill ban pending in Massachusetts effective July 1999. [One million pounds of monitors is approximately 33,000, 30 pound computer monitors.]

- DMCs current capacity is 6.5 million pounds in a 40-hour workweek. DMC can process this large capacity because all of their equipment is automated to recycle whole monitors or CRTs.

- DMC recycles glass, steel, copper, plastic, and aluminum from the computer monitors.

- All the glass from CRTs that DMC recycles is sent to a lead smelter. Typically they ship the glass by rail in quantities of about 100,000 pounds (50 tons).
- The primary lead smelter uses the glass silicate in place of a commercial fluxing agent and recovers the lead.

- DMC's recycling process entails 5 steps to breakup and separate the computer monitor materials: (1) shredding; (2) ferrous separation; (3) pulverizing the glass; (4) sifting the glass; (5) containerizing the copper, aluminum, and plastic.

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Contacts made by Tom Uden:

Robert Bouma, Noranda, Toronto, Ontario, (416) 982-7237. November 4, 1998.

Questions:

(1) What is the cost for disposal/recycling of CRTs at your facility?
(2) Where do CRTs fit in your process?
(3) How many CRTs are processed each year?
(4) What types of companies/organizations typically provide you CRTs?
(5) Any other general information?

Responses:

- The price for taking CRTs is several hundred dollars, but typically less than $500 per ton. This value is closely guarded, because various companies "compete" for monitors. The fee is the money maker in this operation, not the copper, silica, and precious metal values recovered. CRT glass is less valuable than a whole monitor, because there are no precious metals or copper in the CRT glass.

- CRTs are introduced whole, or shredded into a copper smelter. Copper (principally from the yoke) and small amounts of precious metal are recovered. Lead is discarded in the furnace slag to a secure impoundment. CRTs also contain silica, which is useful as a fluxing agent.

- Noranda accepts approximately 1,000 - 2,000 tons of monitors per year. [This weight range represents between 50,000 to 130,000 monitors.] Weight assumptions would allow calculation of absolute numbers. The principle input is whole monitors, as opposed to broken CRT glass, or only the CRT. TVS are generally too large for the shredder. Some non-viable TV tubes are obtained from OEMs.

- Generally electronic scrap brokers supply the CRTs. Often, these brokers will go into an office facility, to obtain the highest value components (the computer "boxes"). They may attempt to refurbish and sell monitors. However, most brokers take the monitors even though they do not want them. They take the monitors as part of a package deal, to get the computers which contain much greater levels of precious metals. Another source of monitors is from OEMs. If an OEM (e.g., IBM, Digital, HP) replaces an entire office's PCS, the broker, as part of a package deal, will take away the old systems, including monitors. Taking the monitors is part of the service.

- CRT glass direct from OEMs (broken in manufacturing for example) is an ideal input for their lead smelter in New Brunswick. The glass must be clean, because plastic fouls the sulfuric acid plant that is part of the process.

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Cliff Asbury, Doe Run, Glover, MO, (573) 546-7492, x-237. November 10, 1998.

Questions:

(1) What is the cost for disposal/recycling of CRTs at your facility?
(2) Where do CRTs fit in your process?
(3) How many CRTs are processed each year?
(4) What types of companies/organizations typically provide you CRTs?
(5) Any other general information?

Responses:

- A general number for disposal of CRTs at Doe Run is $140 per ton of CRT glass. The number will vary depending on the quality of the glass, and the volume (Doe Run offers high-volume discounts).

- CRT glass is introduced as a fluxing agent at the primary smelter. Some lead is recovered from the lead content in the glass, but the primary value is as a fluxing agent. The CRTs are exempt from being manifested to the smelter, under a 50% material substitution provision.

- 100-125 tons of CRT glass are processed each year. [This weight range represents between 5,000 to 8,000 monitors.] CRT glass is generally shipped in "gaylord" boxes. These are 1 cubic yard cardboard boxes. Doe Run would like to receive the glass in dump trucks, or rail cars. This would eliminate the need to dispose of several thousand boxes a year.

- CRT glass comes from recovery services, that scavenge used computers. Some try to refurbish the computers, often sending them overseas. A lot of these companies are primarily interested in the precious metal and copper values in the computer "box." They take the monitors as part of the deal, and have to get rid of the glass. They only dump the glass after fully disassembling and recovering valuable components from the monitor.

- One broker/processor (DMC) sends glass to Doe Run crushed to 3/8 inch particles. The crushing is good for the broker/processor (because they can use magnetic separation techniques to get the metal out), and for Doe Run (because fewer contaminants remain in the glass, and the glass is already crushed for introduction into the smelting furnace).

- Mr. Asbury mentioned three brokers/processors:
  - Asset Recovery, MN; 612-602-0789, Bruce Janovic. This may be an affiliate of Digital Corp.
  - DMC, NH; 603-772-7236, Mike Mogliano.
  - SEER, FL; 800-376-7888, Mike Flynn.

- Mr. Asbury expressed concern that the current CSI proposal favors glass-to-glass recycling. Doe Run does not want to lose CRTs as an input and revenue generator. [CRTs may represent an important revenue source, especially when the price of lead is low.]

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Mike Flynn, SEER (Secure Environmental Electronic Recovery), Tampa, FL. (888) 600-7337. November 11, 1998.

Questions:

(1) What is the cost for disposal/recycling of CRTs at your facility?
(2) Where do CRTs fit in your process?
(3) How many CRTs are processed each year?
(4) What types of companies/organizations typically provide you CRTs?
(5) Any other general information?

Responses:

- SEER charges $7.50 per computer monitor, $12.50 per table-top television, and $35.00 per console television.

- Typically whole computer systems are recovered from companies. Usually this results from a modernization of company hardware. Very often, these companies have old equipment in a warehouse that is removed at the same time. SEER determines if the equipment (including monitor) has resale or refurbishment value. If re-sale or refurbishment is not an option (as with older equipment that has been stored for a while) demanufacturing occurs. Some consumers give SEER computer monitors and televisions, if they are concerned with "doing the right thing" environmentally.

- For monitors, the mercury switches, and valuable parts are removed. The vacuum is released. The front panel is cut away. CRTs are shipped in gaylord boxes. 950 pounds of CRTs fit in one box, although Mike could not say how many CRTs this represents. [950 pounds of CRTs is approximately 30 CRTs.] They currently ship to Doe Run only. Mr. Flynn is going to visit Envirocycle next week to look into sending some CRT glass to them. He predicts that there will be increased disposal in the near future, and that he will need more than one outlet for CRTs. If SEER contracts with Envirocycle, the monitor flow would be: (1) end user, (2) SEER, (3) Envirocycle, (4) Techniglass.

- Mr. Flynn did not have the number of CRTs processed per year available at the time of the call.

- Companies with a large computer base, usually located in large office buildings or complexes, are SEER's typical customers. They find out about SEER through Subtitle D landfills. For instance, many CWM Inc. Subtitle D landfills in the area refer companies with large CRT volumes to SEER. It was not apparent whether this is a formal arrangement, although it seems unlikely.

- Florida recently adopted Universal Waste Regulations, and SEER is a Universal Waste Handler and Transporter. This allows them to handle batteries and mercury switches. Mr. Flynn claimed that when the CRTs are brought to SEER, they are in monitor format and are

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therefore still potentially a viable product. They are therefore exempt from RCRA manifest and other requirements. When they are sent to Doe Run, they are exempt because they are primary process feed. He is not sure what the RCRA status of shipping to Envirocycle would be; he intends to find out next week.

- Mr. Flynn also expressed concern that the CSI proposal will preferentially treat the glass-to-glass channel. He thinks that any increased regulations on smelters would create a problem, because the glass-to-glass processors do not have the capacity to handle the projected increase in CRT disposal.

Various, Chemical Waste Management (CWM). November 2-3, 1998.

Questions:

(1) What is the cost for disposal/recycling of CRTs at your facility?
(2) Where do CRTs fit in your process?
(3) How many CRTs are processed each year?
(4) What types of companies/organizations typically provide you CRTs?
(5) Any other general information?

Responses:

- The disposal cost is $285/cu yard for macroencapsulation, and $150-175 for 55 gal drum of whole monitors/CRTs (Street, AL). In addition, for Model City NY, if the shipment is from out of state it is subject to a $27/ton state hazardous waste tax. All shipments to the facility are subject to a 6% town tax, and a 7% sales tax (Customer Service, NY). Mr. Street mentioned that LA has a more favorable tax structure.

- CWM is a RCRA Subtitle C facility, with the ability to stabilize lead leaching components. Monitors would be encapsulated (without crushing/breakage) in impermeable containers, with a concrete type substance poured around them (Customer Service, NY).

- Model City (Buffalo) NY and Emelle AL could not think of specific instances of CRT disposal. (Although Dr. Street in Emelle thought that the NY facility would likely deal with CRTs; he suggested talking to their environmental person, Jill Knickerbocker, who did not return my calls). The Lake Charles LA facility contact could recall one shipment of CRTs that was macroencapsulated (Grant, LA).

- The contact at Emelle thought that shipments of monitors would likely come from Fortune 500 companies with strong environmental programs. He thinks that many monitors are being recycled, some by the same facilities that recycle Hg lamps (Street, AL).

- Contacts:
  CWM Model City NY (716) 754-8231 Jill Knickerbocker

CWM Emelle AL	(205) 652-9721	Dr. Jim Street
CWM Lake Charles LA	(318) 583-2144	Chuck Grant

Heather McCarthy, Clean Harbors of Braintree. May 9 and 24, 2001.

Questions:

(1) Have you mostly received CRTs from the users, brokers, or other types of businesses?
(2) Are the CRTs mostly sent to you whole or crushed?
(3) What are your rates for stabilization and disposal of bulk waste?
(4) Can you estimate how many CRTs or how many tons of CRTs your facility has processed in the last year?
(5) Does your company provide transportation services?

Responses:

C CRTs are mostly received from businesses, but some are received from brokers.

C CRTs are received whole in flex bins, which are similar to but smaller than gaylord boxes.

C CRTs are dismantled and recycled to the maximum extent possible in their Bristol, CT facility. Clean Harbors charges $300 to $500 per flex bin depending on the size and frequency of shipments. The CRT glass is sent to Canada where it is crushed, treated, and disposed. Clean Harbors does not have a minimum charge for shipments of CRTs

C Do not have a current estimate of the number or tons of CRTs processed.

C Clean Harbors provides transportation services and charges a flat rate of $150 per shipment for the Boston area. For locations farther away (e.g., Maine) they charge about $300 per shipment.

Lisa Humfry, Envirosafe Services of Ohio. May 10, 2001.

Questions:

(1) Have you mostly received CRTs from the users, brokers, or other types of businesses?
(2) Are the CRTs mostly sent to you whole or crushed?
(3) What are your rates for stabilization and disposal of bulk waste?
(4) Can you estimate how many CRTs or how many tons of CRTs your facility has processed in the last year?
(5) Does your company provide transportation services?

Responses:

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- CRTs are mostly received from brokers, but some are received from businesses. One customer consolidated CRTs from many of its facilities and crushed the CRTs before sending them to Envirosafe. Envirosafe macro-encapsulates CRTs sent in poly drums, and encapsulates whole CRTs. If the CRTs are sent crushed in a roll-off container, they will stabilize the CRTs for disposal.

- CRTs sometimes are received whole, but mostly crushed in roll off containers.

- The rate for crushed CRTs in a roll-off container is $160 per ton. The rate for whole monitors is $360 per cubic yard. The rate for whole CRTs in drums is $150 per drum. Envirosafe does not have a minimum charge for shipments of CRTs.

- Envirosafe received no CRTs last year and about 20 to 30 tons the previous year.

- Envirosafe subcontracts out transportation.

Mark Cardamone, F&M Bay Electronics Co. Inc./SEER Inc., Tampa, FL. (813) 621-8870. May 14, 2001.

Questions:

(1) What do you do with the CRTs you receive?
(2) Who do you receive CRTs from? e.g., the users, brokers, or other types of businesses?
(3) What are your rates for processing monitors?
(4) Can you estimate how many CRTs or how many tons of CRTs your facility has processed in the last year?
(5) What do you do with the CRT glass?
(6) Does your company provide transportation services?

Responses:

- All monitors that were manufactured during or after 1996 are tested to see if they are operational. About 10 percent of the CRTs received are resold. The remaining monitors are demanufactured and the plastic, steel, aluminum, and copper are recycled. The bare CRTs are cut in half to separate the panel from the funnel. The CRT glass is sent to Envirocycle and to Dlubeck Glass.

- Most of the monitors are received from original users. Monitors are also obtained from municipal solid waste facilities that remove the CRTs from the solid waste stream at landfills or transfer stations.

- For monitors that are 17 inches or less, they charge $6 to $7.50 per monitor. For monitors that are larger than 17 inches, they charge $9.50 per monitor. For bare CRTs, they charge $4.00 per bare CRT.

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- The facility processed 40,000 CRTs in the last year. This includes both TVs and monitors.
- The CRT glass is sent to Envirocycle and to Dlubeck Glass.
- Transportation services are provided and include scheduled pickups through common carriers and their own trucks. Local pickup includes a range of 50 miles and costs $25 per pickup. In Florida transportation costs are generally $25 to $150 per pickup.

Jack Hope, WasteNot Recycling, Sterling, VA. (703) 787-0200. May 15, 2001.

Questions:
(1) What do you do with the CRTs you receive?
(2) Who do you receive CRTs from? e.g., the users, brokers, or other types of businesses?
(3) What are your rates for processing monitors?
(4) Can you estimate how many CRTs or how many tons of CRTs your facility has processed in the last year?

Responses:
- WasteNot Recycling is a not for profit organization that trains and employs developmentally disabled adults. They only take functional monitors right now. They are looking into the options for demanufacturing monitors in the future.
- Monitors are received from local companies, such as ATT, SAIC, and Boeing.
- There is no charge for donating monitors.
- Mr. Hope did not have an estimate of the number of computer or monitors received.

Greg Voorhees, Envirocycle, Halstead, PA. (570) 879-2862. April 25, 2001.

Questions:
(1) What percent of the CRT glass that you receive is sold as fines?
(2) What percent of Envirocycle's processed CRT glass is sent to lead smelters?
(3) What is Envirocycle's recycling capacity?
(4) Is the facility in North Carolina that is mentioned on your web site open yet?
(5) What do you charge for intact whole monitors?
(6) What percent of CRTs are received as whole monitors, bare CRTs, or crushed glass?

Responses:

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- None.

- All of the fines generated in the processing of CRTs are sent to a primary lead smelter, for which Envirocycle must pay. The processing of CRTs generates about two percent fines by weight. Envirocycle is working to improve the efficiency of its process to reduce the generation of fines.

- Envirocycle is currently operating at about 20 percent of its capacity in its Halstead, PA facility. Envirocycle's current operating tempo is about 1.5 million pounds per month

- The North Carolina facility will not be opened. Two other locations are being pursued and will be open by the end of the year. One facility will be located in the north east and the other will be on the west coast.

- Envirocycle charges about $5 to $6 per monitor for whole monitors. The actual price paid is volume dependant.

- About 50 to 60 percent of the glass received is "dirty-mix with no metals." This glass comes from other demanufacturing facilities. Envirocycle still receives about the same amount of CRT glass from OEMs as in 1996.

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Appendix I

Bibliography

Aanstoos, T., Mizuki, C., Nichols, S., and Pitts, G. *CRT Disposition: An Assessment of Limitations and Opportunities in Reuses, Refurbishment, and Recycling in the U.S.*, IEEE International Symposium on Electronics & the Environment, 1997.

"April Showers Grew May Color TV Sales," Consumer Electronics Manufacturing Association Homepage, www.cemacity.org/cemacity/gazette/files2/vidmay98.htm, October 6, 1998.

"Closed-Loop CRT Recycling: Why Europe and the U.S. Differ?" Cutter Information Corporation, Product Stewardship Advisor, www.cutter.com/psa/fulltext/1997/09, Volume I, No. 4: September 1997.

"Consumer Electronics Industry Forecast for 1997 – 27.6 Million New TV Sets and Much More," Consumer Electronics Manufacturing Association Homepage, www.cemacity.org/cemacity/gazette/files2/vidmay98.htm.

DPRA Incorporated. "Regulatory Impact Analysis of the Proposed Rule for a 180-Day Accumulation Time for F006 Wastewater Treatment Sludges," August 4, 1998.

Notes from personal communication with Greg Voorhees from Envirocycle, 1996.

Data series for Personal Computers, Color TV Receivers, Color TV Receivers, Monochrome TV Receivers – U.S. Sales to Dealers, Electronic Industries Alliance, 1998.

Department of Environmental Protection, DEP's 1998 CRT/Electronics Recycling Strategy Cost/Benefit Analysis, May 1, 1998.

DMC Monitor Recycling, DMC Electronics Homepage, www.nh.ultranet.com/~dmc/monitor.html, accessed October 20, 1998.

Electronic Industries (EIA) Sector, Cathode Ray Tube Industry Subsector Presentation, September 26-28, 1994.

Electronics Industry Sector-Cathode Ray Tube Industries, Alternative Strategies Work Group, *Green Paper on the Environmental Issues and Needed Research in Color Displays*, September 27-28, 1995.

Energy and Environmental Analysis, *Analysis of Heavy Duty Truck Fuel Efficiency to 2001*. September 1991.

US EPA ARCHIVE DOCUMENT

Envirocycle History, Envirocycle Homepage, www.enviroinc.com/env2.html, accessed October 16, 1998.

Fisher, Jim. "Poison PCs," Salon.com, September 18, 2000.

Fox, Barry. "Green TV Laws Store Up Mountain of Trouble," New Scientist, September 4, 1993.

Goldberg, Carey. "Where Do Computers Go When They Die?" The New York Times, March 12, 1998.

Holusha, John. "Where Old Computers Parts Are Given New Lives, The New York Times, June 10, 1996.

ICF Inc., *Overview of Cathode Ray Tube Recycling*, February 27, 1997.

ICF Inc., *Economic Impact Analysis for the Military Munitions Final Rule*, June 1996.

ICF Inc., Memorandum to Allen Maples, EPA. "Baseline Costs and Cost Comparisons Between Hazardous Waste, Hazardous Material, and Non-Hazardous Shipments." August 31, 1998.

Joyce, Amy. "Reduce, Reuse, Reboot." The Washington Post, January 21, 2000.

"The Long-Term Future of CRT Glass Recycling: How NEC Is Planning Ahead." Cutter Information Corporation, Product Stewardship Advisor, www.cutter.com/psa/fulltext/1997/09, Volume I, No. 6: November 1997.

Macauley, Molly, Palmer, K., Shih, Shih, J., Cline, S., Holsinger, H., *Modeling the Costs and Environmental Benefits of Disposal Options for End-of-Life Electronic Equipment: The Case of Used Computer Monitors*. Resources for the Future, Discussion Paper 01-27, June 2001.

Matthews, Scott H., McMichael, Francis Co., Hendrickson, Chris T., Hart, Deanna, J., *Disposition and End-of-Life Options for Personal Computers*, Carnegie Mellon University: Green Design Initiative Technical Report #97-10, July 7, 1997.

The Microelectronics and Computer Technology Corporation (MCC), *Environmental Consciousness: A Strategic Competitiveness Issue for the Electronics and Computer Industry. Comprehensive Report: Analysis and Synthesis, Task Force Reports and Appendices.* March 1993

Monchamp, A., Evans, H., Nardone, J., Wood, S., Proch, E., and Wagner, T., Cathode Ray Tube Manufacturing and Recycling: Analysis of Industry Survey. Electronics Industries Alliance, Spring 2001.

National Recycling Coalition, "Proper Management of Cathode Ray Tubes (CRTs)." January 13, 2000. www.nrc-recycle.org/Programs/electronics/crtmgmt.htm#export1

National Safety Council, *Electronic Product Recovery and Recycling Baseline Report, Recycling of Selected Electronic Products in the United States.* May 1999.

Paik, Angela. "Garbage In, Value Out." The Washington Post, December 30, 1999.

Summary of Envirocycle, Inc, Electronics Processing Associates, Inc., Summary of Conversion Technology, November 07, 1996.

U.S. Bureau of Census. "Computer Use in the United States: October 1993," www.census.gov/population/socdemo/computer/compwork.txt.

U.S. Bureau of Census. Newburger, Eric, C. "Computer Use in the United States: October 1997," September 1999.

U.S. Environmental Protection Agency, Region 1. *Analysis of Five Community Consumer/Residential Collections, End-of-Life Electronic and Electrical Equipment.* EPA-901-R-98-003, April 1999.

U.S. Environmental Protection Agency, Region 10. "List of Computer & Electronic Reuse & Recycling Options." EPA web site: epanotes1.rtpnc.epa.gov:7777/r10/owcm.nsf, October 1998.

U.S. Environmental Protection Agency, Office of Solid Waste, Economics, Methods and Risk Analysis Division. *Unit Cost Compendium*. September 30, 2000.

U.S. Environmental Protection Agency, Office of Solid Waste. *Capacity Analysis for Land Disposal Restrictions - Phase IV: newly Identified Toxicity Characteristic Metal Wastes and Mineral Processing Wastes (Final Rule), Background Document*. April, 1998.

U.S. Environmental Protection Agency. *Supporting Statement for EPA Information Collection Request Number[] "Reporting and Recordkeeping Requirements for the Proposed Rule on Cathode Ray Tube (CRT) Glass Reuse."* Working Draft, October 9, 1998.

"Video and Computer Industry Facts," Consumer Electronics Manufacturing Association Homepage, www.cemacity.org/cemacity/digital/files/hdtvfact.htm, accessed October 6, 1998.

US EPA ARCHIVE DOCUMENT