Draft Final Report

Analysis of Discarded CRTs in Florida: Volume Projections and Disposal Management Options

Amy Chan Hilton and Gang Chen

Department of Civil and Environmental Engineering

FAMU-FSU College of Engineering

Florida State University

2525 Pottsdamer Street, Tallahassee, FL 32310

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Abstract

Motivation: The average number of televisions per home was 2.4 in 2001 (US Census, 2005). According to the U.S. Census Bureau, 62% of Americans owned one or more computer in 2003. This was an increase from 56% in 2001 and 8% in 1984 (Day, et al. 2005). Additionally in 2001, 98.2% of homes had at least one television, which is up from 87% in 1960. High definition televisions are rapidly replacing the standard definition television. CRTs are quickly becoming obsolete in developed countries and are a major component in the electronic and hazardous waste stream (National Recycling Coalition, 1999). As a result, it is critical to be able to estimate and project the quantity of CRTs that will be disposed. Equally as important is determining the capacity of demanufacturing, recycling, and disposal facilities for discarded CRTs. Management approaches and policies need weigh the economic, environmental, and practical aspects when recommending CRT disposal strategies.

Objectives: This research proposes to conduct a comprehensive study of the current CRT waste situation in the state of Florida (volume of CRT discarded, existing facilities, practices) as well as make projections on trends in future CRT waste streams. The goal of this research to answer questions about trends in volume of discarded CRTs in the future, current CRT waste management practices and trends, and capacity for handling increase in CRT disposal. A materials flow model that tracks CRTs from the time a consumer purchases a CRT television or monitor to when it is stored, reused, recycled, and disposed was developed. Two versions were developed that differed in the way the end-of-life (EOL) cycles of the CRTS were handled: the Split EOL and Lumped EOL models. A series of scenarios that varied the disposal options were analyzed using both versions of the model. The user-friendly, spreadsheet management tool allows managers, regulators, and policy makers to compare scenarios for the recycling and disposal of CRTs in the state of Florida.

Benefits to End Users: The results of this project have multiple direct benefits to end users. Projections on future CRT waste streams are necessary in order to align management practices, infrastructure options, and potential policies with the demands of future CRT discards. Synthesis of data on the current status of CRT processing and disposal practices in Florida is beneficial to municipalities, reuse, demanufacturing, and recycling facility managers, and regulators. Estimates on future CRT trends, based on the materials flow model, provide data for managers and policy makers on the local and state level make decisions about expanding infrastructure to handle CRT waste management. The spreadsheet-based management tool developed in this research allows end users to analyze policy and management practices not specifically addressed in this research and/or use local- or region-specific input data. Issues such management practices and policy changes can be analyzed with this tool to assist the end user.

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1. Background and Motivation

An estimated 300,000 tons of electronic waste (e-waste or e-scrap) was disposed in landfills in 2000 (Gable and Shireman, 2001), with cathode ray tubes (CRTs) comprising approximately one-third of this mass. CRTs can range in weight between 8 and 70 lbs depending on the size of the television or computer monitor (Townsend et al., 1999). Exposure to lead is the primary concern of CRT handling and disposal. Lead exposure may cause moderate to severe health effects especially in children. Lead can cause damage to the nervous system, behavioral problems, reproductive issues, and increased chance of miscarriage, headaches and many more illnesses (US EPA, 2004).

Estimates anticipate that the amount of e-scrap will increase 16-28% each year, which is three times faster than the average growth rate of municipal solid waste (EEA, 2003). Furthermore, data indicate that the rate at which CRTs have become obsolete has steadily increased and was similar to the rate of CRT production in 2003 (Kang and Schoenung, 2005). CRTs are significant e-scrap products given their volume, recycling costs, and disposal restrictions in certain states (Kang and Schoenung, 2005). Approximately half of the mass of a TV or computer monitor is in the CRT (Lee et al., 2004), and about one-third of the total mass of a CRT is lead-containing glass while other CRT components also contain lead (Méar et al., 2006). Most CRTs contain as much as 4 to 8 lbs of lead (Kiuchi et al, 2001). Currently a few recycling and reuse options are available for CRT glass – glass-to-glass, glass-to-lead and lead smeltering – with the former being the preferred process in part because it is considered a closed loop recycling process (Kang and Schoenung, 2005). However, glass-to-glass recycling is labor intensive and expensive and limited users of the recycled material exist. In the U.S., a few glass-to-glass recyclers exist in Arizona, Ohio, and Pennsylvania. In 2005, approximately 14% (or 24,000 tons) of CRT glass collected for recycling was sold to markets abroad for glass-to-glass processing, and about 6% (or 10,000 tons) of CRTs go to lead recovery in North America (US EPA, 2010). Details of electronics demanufacturing processes are reviewed in Williams (2006).

With the June 2009 (postponed from the original February 2009 deadline) transition to over-the-air digital television broadcasts and the decrease in prices for newer technologies such as LCD and plasma, it is anticipated that the CRT waste stream will further increase when CRT television sets are replaced. Electronics recyclers estimate that 1 in 4 households will dispose of at least one television because of the digital conversion. Based on Florida's estimated population of 18,680,000 and households of 7,425,000, this forecast estimates that approximately 1.85 million televisions (or approximately 1 television for every 10 Floridians) will be discarded in the next few years (FDEP, 2008). In another study, the National Safety Council (1999) estimated that between 1999 and 2003, the number of obsolete televisions in Florida increased slightly and was approximately 1.4 million units, while the number of obsolete computer monitors increased over 40% from about 900,000 to 1.3 million units, with only a small percentage being recycled (Figure 1-1).

The estimates on the number of CRTs that will be discarded and recycled vary depending on the source. In 2003, Kessler Consulting, Inc., in partnership with Seminole County, conducted surveys with donation centers and thrift stores on the electronic equipment received from residents and the centers' infrastructure to handle, reuse, recycle, and/or dispose of the

electronics (Kessler Consulting, Inc., 2003) and with Florida households on their practices for recycling and disposing of televisions and computer monitors (Kessler Consulting, Inc., 2004). With the recent digital broadcast conversion, older trends may not reflect future trends very accurately, and thus it is critical that projections on the volume of CRTs discarded are made and potential CRT waste disposal and recycling options are assessed. This is important given the amount of lead and other hazardous materials contained in CRTs. Furthermore, limited statewide data for Florida are readily available to help policy makers, waste managers, and regulators identify best management options for discarded CRTs.

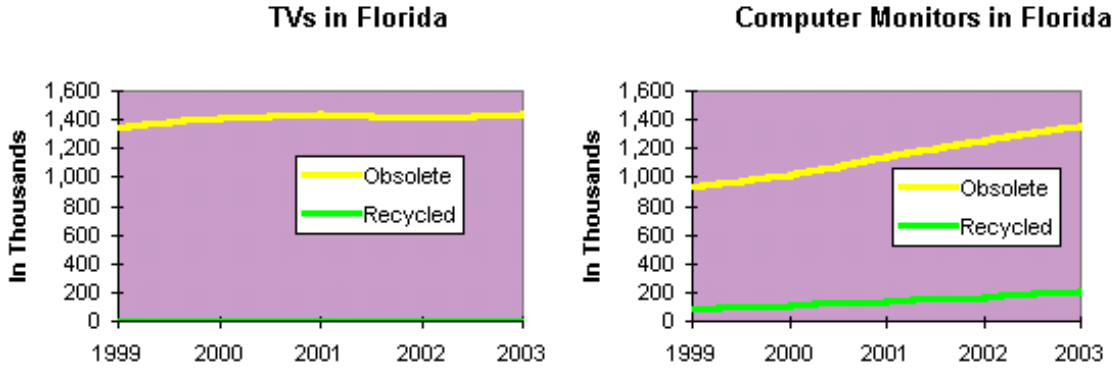


Figure 1-1. Trends in number of obsolete and recycled televisions and computer monitors in Florida, 1999-2003 (FDEP, 2008c; data from National Safety Council, 1999).

1.2 Research Objectives

The goal of this research to answer questions about trends in volume of discarded CRTs in the future, current CRT waste management practices and trends, and capacity for handling increase in CRT disposal in Florida. These questions include:

- What are the trends in the volume of CRTs discarded in Florida – both currently and expected in the near future?
- What is the currently available infrastructure for handling disposed CRTs from Florida?
- What are the current capacities of existing disposal and recycling facilities for CRT components, and will they be able to handle future volumes?
- What are the current practices in Florida for CRT disposal management, and how can they be improved?

In order to provide insight on these topics and to help answer these questions, the research objectives of this project are to:

1. Consolidate data on CRT waste volume and current management practices in Florida.
2. Develop a model to estimate future volumes of discarded CRTs and required infrastructure in Florida.
3. Analyze CRT disposal management options for Florida.

The overall approach of this research is to track CRTs throughout their life cycle, from production to usage to recycling and disposal. The focus of this study is on discarded CRTs from both color television sets (TVs) and computer systems (monitors).

2. Summary of Pertinent Literature

2.1 Electronics Waste Management Legislation

Currently, no national strategy exists for electronics disposal management. The creation of the National Electronics Product Stewardship Initiative (NEPSI) has resulted in ongoing conversations regarding a national system for electronic management between state and local government, U.S. EPA, electronics manufacturers, recyclers, and non-governmental organizations (Product Stewardship Institute, 2003). This issue of e-scrap also was brought to the U.S. Senate in 2005, and it was found that regulatory and economic factors often discourage the recycling and reuse of electronics (US GAO, 2005).

Nevertheless, some states have legislation and/or strategies that deal specifically with electronic wastes and CRTs in particular. Because of specific needs and constraints, these states approach the CRT problem in different ways although their overall goals are similar – to decrease the amount of lead from CRTs that end up in landfills or incinerators and to increase the recycling of CRTs (Price, 1999). For example, Massachusetts, California, Maine, and Minnesota have banned the disposal of CRTs in municipal landfills (US GAO, 2005). Kollikkathara et al. (2009) reviewed how legislation, policies, and management approaches for solid waste include e-scrap have evolved over the past few decades in the US. As of June 2010, state recycling laws that address monitors exist in 23 states and 1 city (New York City) and TVs in 19 states and 1 city (Electronics TakeBack Coalition, 2010b). As of May 2010, 23 states have passed legislation mandating electronics recycling, with all except for California using the producer responsibility approach (Electronics TakeBack Coalition, 2010a). The producer responsibility approach requires manufacturers to be responsible for paying for recycling; in contrast, the consumer fee approach used by California places the costs onto the consumer.

In Europe the Waste Electrical and Electronic Equipment (WEEE) Directive was passed into law in January 2003 with the intent of redirecting disposed electronics away from landfills and incinerators and encouraging environmentally sound reuse and recycling. Starting from August 2005, "producers of electronic products are required to finance and implement strategies to achieve a 4kg/person/year collection goal" and reach specific recycling rates for recovered materials (Product Stewardship Institute, 2003). Elsewhere, concerns about export of e-scrap to China also have been raised (Ni and Zeng, 2009).

2.2 Additional Scientific Studies

Several studies have been conducted to investigate the management of e-scrap (which also is known is e-waste). Widmer et al. (2005) provided a comprehensive global summary of e-scrap generation and disposal, as well as legislation. Kang and Schoenung (2005) provided a similar review of e-scrap trends, recycling and collection programs, and material recovery technology options in the U.S. Sinha-Khetriwal et al. (2005) compared the e-scrap recycling practices in two countries that are very different economic and environmental rankings as well as in their history with e-scrap management – Switzerland and India. Kiatkittipong et al. (2008) compared the environmental impacts, via energy consumption, of replacing existing

electronic products with those using newer technology, such as replacing CRT computer monitors with LCD monitors. They found that while LCD monitors contribute to less environmental impacts compared to CRT monitors, it may take as long as 16 years to realize the benefit of reduced energy consumption of LCD monitors compared to CRTs.

Other studies have focused on modeling, predicting, and/or analyzing e-scrap flows and management options. Most studies have focused on computer e-scrap, while a few studies have included television CRTs (Dwivedy and Mittal, 2010; Kang and Schoenung, 2005; Lee 2007; Méar et al., 2006; US EPA, 2007, 2008). Kang and Schoenung (2006) developed a model to estimate future amounts of e-scrap from computer equipment in California and the consequent infrastructure needed required for CPU and CRT recycling. Macauley et al. (2003) developed a model to simulate end-of-life CRT management options, conducted a cost-benefit analysis, and compared several disposal practice options. Steubing et al. (2010) developed a material flow analysis model to predict computer waste (desktop and laptop computers and CRT and LCD monitors) generation in Chile. Dwivedy and Mittal (2010) developed a time-series model with multiple lifespans to predict quantities of electronic wastes, including computers, TVs, and large appliances, in India.

Lundy (2006) conducted a survey of municipal solid waste facilities, demanufacturers, and recycling centers that handle CRTs throughout Florida on the volume of CRTs processed at these facilities, recycling practices, types and form of waste received, and associated costs. Results indicated that the data and practices varied widely across the state. Additionally, Lundy (2006) performed an environmental systems analysis to identify optimal fees and CRT materials flow necessary to support CRT recycling.

Additional studies have been conducting investigating specific user behavior aspects of e-scrap management. For example, Nixon and Saphores (2007) made recommendations on population groups that may be targeted for recycling fees in California. Saphores et al. (2009) conducted a national survey of 2,136 US households and applied the data to estimate the quantity of e-scrap stored in households and concluded that more e-scrap may be in storage than previously estimated by US EPA (2007, 2008). Gutiérrez et al. (2010) developed a survival analysis and competing risks analysis for estimating the household end-of-life (EOL) duration before disposal for household appliances, including the TV, refrigerator, microwave oven, and iron. In contrast, Linton et al. (2005) focused on broader issues of CRT TVs such as inventory policy, in which CRTs may be required to be phased out, user storage behavior, and disposal incentives.

3. Task 1: Collect CRT volume and disposal data

The goal of this task was to provide answers to the questions: 1) What are the current trends in the volume of CRTs discarded in Florida; 2) what are the current practices in Florida for CRT disposal management; 3) what is the currently available infrastructure for handling disposed CRTs from Florida; and 4) what are the current capacities of existing disposal and recycling facilities for CRT components? Efforts were made to answer all four of these questions via surveys to public and private sectors that handle electronic waste. The research team collected recent and current data on the volume of CRTs disposed and management practices and identified past and recent trends in Florida. This information helps provide a snapshot of the current conditions in Florida.

3.1 Methodology

During Spring 2009, we worked closely with Jack Price and Raoul Clarke at the Division of Waste Management at the Florida Department of Environmental Protection (FDEP) to develop the surveys and interview questions so that a standard format may be used. See Appendix A for the three surveys circulated to 1) household hazardous waste (HHW) managers, 2) electronics recycling facilities, and 3) donation centers. The initial invitations to participate in the 2009 surveys were sent via email during February-March 2009 and during January-February 2010 for the 2010 surveys. Mr. Price and Mr. Clarke at FDEP assisted with the distribution of the surveys to county HHW managers and electronics recycling facilities through listservs that they maintain.

The current volume of discarded CRTs in the waste stream in Florida (such as those at, municipal disposal facilities and recycling facilities) was estimated. Through the surveys we investigated existing CRT demanufacturing (in which the CRT may be separated from the rest of the monitor), recycling, and disposal practices existing in Florida or are used by municipalities and facilities in Florida. Information on the number, locations, capacities, and other limitations of facilities that handle CRTs were collected. We also obtained information on the costs and fees related to each of these disposal options. Although not directly related to this project, data on quantities of computers and laptops received also was collected from the surveys. This data and information currently was collected using e-mail surveys and telephone interviews.

Through the spring 2009 round of surveys, we received responses from 13 HHW managers, 4 electronics recycling facility, and 1 donation center. Responses from 13 counties and 4 recycling centers and 1 donation center, specifically: Seminole (Jane Marshall), Hendry (Juan Guare), Pinellas (Joseph Fernandez), Sarasota (Lois Rose), Alachua (Kurt Seaburg), Broward (Karen Smith), Citrus (Owen Carney), Charlotte (Tim McMullen), Putnam (Nancy Jones), Escambia (Jim Howes), Leon (Cyndy Brantley), Orange (Odette Padron), Lee (Emory); Southeastern Data (Allan Jackson), Global EH&S (Steve Craig), Unicor Recycling (Kevin O'Hearn), A1 Assets (David Leavitt); Goodwill Big Bend (Randy Jones). Of the 13 counties that responded to the 2009 survey, 4 have small populations (39,000- 150,000 residents), 6 have mid-size populations (225,000-450,000 residents), and 3 have large populations (920,000-2 million residents).

In January 2010, we implemented a follow-up survey to HHWs and recycling centers. While this second survey was not part of our initial project plan, we felt that a follow-up after the June 2009 digital television signal conversion would provide additional useful information. The survey questions were similar to those asked during the spring 2009 surveys, with a focus on recent changes. The spring 2010 survey questions are detailed in Appendix B.

During the spring 2010 survey, 11 counties responded, with 10 of which also responded to the 2009 survey. These counties were Alachua (Kurt Seaburg), Broward (Karen Smith), Charlotte (Tim McMullen), Citrus (Owen Carney), Hendry (Patricia Ashley), Leon (Cyndy Brantley), Orange (Oscar Ramos), Pasco (Farouk M. El-Shamy), Pinellas (Joseph Pinellas and Judy Kujawa), Sarasota (Brian Usher), and Seminole (Jane Marshall). Of these 11 counties, 3 have small populations (39,000- 150,000 residents), 5 have mid-size populations (225,000-463,000 residents), and 3 have large populations (920,000-1.75 million residents). In addition, 4 electronics recyclers responded to the 2010 survey; these were A-1 Assets (David Leavitt), E-scrap (George Fery), SIR International (Abilio Santos), and Southeastern Data (Allan Jackson). Two of the 4 electronics recyclers who responded in 2010 also responded to the 2009 survey.

Between the two round of surveys, a total of 14 counties, 6 electronics recyclers, and 1 regional donation center responded to the surveys. We anticipated that one barrier to the data collection in this project is obtaining responses to the surveys. However, other tasks in this project use the survey data but do not rely solely on this data.

3.2 Results and Discussion

The spring 2009 and spring 2010 surveys provide a snapshot of recent and current trends on the volume, and disposal rate of CRTs in Florida, as well as current management options. Overall, the responses were similar between the 2009 and 2010 surveys, with a few counties noting changes in CRT quantities or disposal options. The overall trends are summarized below. A detailed summary of the individual responses is provided in Appendix C.

The most common method used by the counties for collecting discarded CRTs was drop-off locations at the main solid waste facilities, which is used by all 14 counties responding to the surveys. Three counties also have satellite or mobile locations. Most (9) counties held collection events, with a frequency ranging from once to 14 times a year. Four counties have residential curbside pick-up collection: available throughout the county in Lee, Orange, and Sarasota counties and in the City of Oakland Park in Broward county.

As expected, the majority (50-100%) of the CRTs received by counties are from households while some counties accept items from businesses, accounting for up to 30% of the CRTs collected. CRTs from donation centers make up 0-10% of the amount received by the counties. Counties do not charge its residents for the disposal of CRTs, although a few counties impose a limit on the number of items. Most counties charge a disposal fee for businesses that varies depending on the type of item. The disposal fee charged to businesses is \$0-\$8 per monitor and \$7-\$12 per TV, while other counties charge by total weight, ranging from \$0.15-\$0.50 per lb of CRT to \$75-\$200 per ton.

Tables 2 and 3 summarize the range of responses from the 2009 and 2010 surveys, respectively, regarding the quantity and distribution of CRTs received by the counties, recycling facilities, and donation centers; note that not all counties that responded provided

data and that some counties reported quantities in number of items while others reported total pounds of CRTs received. In both the 2009 and 2010 surveys, the change in CRT quantities received varied from county to county, with some reporting no or slight increases and a few reporting 60% or more increases in the recent months preceding the survey (Tables 3-1 and 3-2). The trends were the same for 2009 and 2010 overall. One notable difference was the responses from the electronics recyclers, in which they observed no or moderate (up to 25% increase) changes in the quantities of CRTs received in spring 2009 but reported a wider range of changes, from a decrease of up to 60% to increase up to 100%, during the months prior to the 2010 survey. County HHW managers and electronics recyclers suggested several of reasons for the changes in CRT quantities received. Counties cited the 2009 digital TV signal conversion as the most common reason (6 out of the 11 HHW responses to the 2010 survey). Other possible reasons included price drops in flatscreen TVs (2 responses), seasonal variations such as Christmas purchases and Superbowl (3 responses), age of the discarded units (1 response), and foreclosures (1 response). Electronics recyclers also cited similar reasons for the changes in the CRT quantities received: price drops (2 responses), digital conversion (1 response), upgrades to LCD monitor (2 responses), and business closings (1 response). Some felt that the potential increases due to the digital conversion was exaggerated and did not observe as large as an increase as previously anticipated.

For the counties responding to the 2009 and 2010 surveys, all store and prepare the CRTs for shipment to a recycling facility, with most using in-state recyclers, and no counties demanufacture the CRTs themselves. The costs for CRT recycling varies for each county, ranging from $0-12 per TV and $0-6 per monitor (Table 3-3), with the costs typically higher for TVs compared to computer monitors since computer monitors often have a higher recycling value compared to TVs. Some counties pay by total quantity rather than unit, with costs ranging from $0.10/lb or $800 per roll-off container. One county (Alachua) incurs a higher processing fee, $15-20 per unit, for console and projection TVs. A few counties have established agreements with the electronics recyclers to not pay for disposal, with one county (Orange) receiving $0.01/lb for monitors sent to the recycler. Counties in general do not have capacity constraints for the storage and processing of CRTs for recycling since they are able to schedule additional pick-ups from the electronics recyclers as needed.

Table 3-1. Quantities of CRTs Received – 2009 Survey Results Summary. Note that the responses shown here indicate the range of individual responses, not a total.

Group	2007 CRTs Received	2008 CRTs Received	Distribution	Changes 2008
Counties	3,500 - 25,000 units 117,000 - 750,000 lbs	6,000 - 25,000 units 155,000 - 660,000 lbs	20-70% monitors, 30-80% TVs	No change - 60% increase
Electronics recyclers	6,500 - 365,000 units	7,500 - 174,000 units	60-99% monitors, 1-40% TVs	No change - 25% increase
Donation centers	1.25 million lbs	1.75 million lbs	35% monitors, 65% TVs	20-35% increase

Table 3-2. Quantities of CRTs Received – 2010 Survey Results Summary. Note that the responses shown here indicate the range of individual responses, not a total.

Group	2009 CRTs Received	Distribution	Changes 2009
Counties	4,500 - 15,000 units 170,000 - 1,080,000 lbs	20-66% monitors, 40-80% TVs	No change - 65% increase
Electronics recyclers	6,800 - 24,000 units	75-95% monitors, 5-15% TVs	60% decrease - 100% increase

Electronics recyclers receive their CRTs from municipalities, government offices, and businesses. Most also hold collection events in coordination with individual counties. The quantity of CRTs received by the recycling facilities responding to the survey varied significantly (Tables 3-1 and 3-2) due to the size of the facilities. Because business contracts account for a large portion of the recyclers' businesses, they receive a larger amount of computer monitors compared to TVs. Some recyclers charge $3-7 per monitor and $10-25 per TV received, while others charged by weight, $0.15-0.50/lb. The two recyclers who do not demanufacture on-site the CRTs charge more to receive TVs compared to computer monitors. The recyclers who demanufacture CRTs send components to various parts and materials recyclers in the eastern and Midwestern U.S. and Canada. With the exception of one facility, the recyclers who responded did not have capacity constraints for the processing of CRTs.

Table 3-3. Collection of CRTs – 2010 Survey Results

Group	Collection type	Source	Collection Fee	Processing Costs
Counties	Drop-off centers: 14 Mobile collection: 3 Curbside: 4 Collection events: 9	Residential: 50-100% Business: 0-30% Donation Centers: 0-10%	For residents: $0 For businesses: $0-$8/monitor, $7-$12/TV, or $0.15-$0.50/lb, or $75-$200/ton	$0-12/TV, $0-6/monitor, or $0.10/lb, or $800/roll-off container
Electronics recyclers	Contracts Collection events Drop-off	Municipalities Government Business Individuals	$3-$7/monitor, $10-25/TV, or $0.15-$0.50/lb TV	NA

4. Task 2: Develop model to estimate future volumes of discarded CRTs and required infrastructure

The results of this task provides tools to answer to the questions: "What are the trends in the volume of CRTs discarded in Florida expected in the near future; and will existing disposal and recycling facilities for CRT components be able to handle projected future volumes?"

Two versions of a user-friendly spreadsheet-based model using materials balance and flow modeling and analysis were developed to track the life cycle of CRTs. The methodology in this task was based primarily on "Approach 2" described in US EPA (2007) (Figure 4-1) and "Approach 1" described in US EPA (2008) (Figure 4-2) while the method described in Kang and Schoenung (2006) also was considered (Figure 4-3). This flow of CRTs is modeled over a period of 35 years in order to make projections on the volumes of discarded CRTs and the infrastructure required to handle the waste stream. The resulting projections form the base case for additional scenario analyses in Task 3.

The modeling and analysis in this task provides the framework for the analysis tool that may be used to identify critical infrastructure and areas that require enhanced public education in order for the state of Florida and municipalities to handle the CRT waste stream. Based on these CRT flow projections, an analysis of whether the existing handling, recycling, and disposal facilities would be able to handle the projected future volumes will be completed. Data collected in Task 1 is used in this analysis for comparison. The model can be used to predict the overall future quantities of CRTs disposed as well as the distribution of future waste streams (for example to recycling, reuse, export). The tool also allows the user to analyze the effects of potential policies, such as banning landfill disposal of CRTs or mandating a specific of recycling rate.

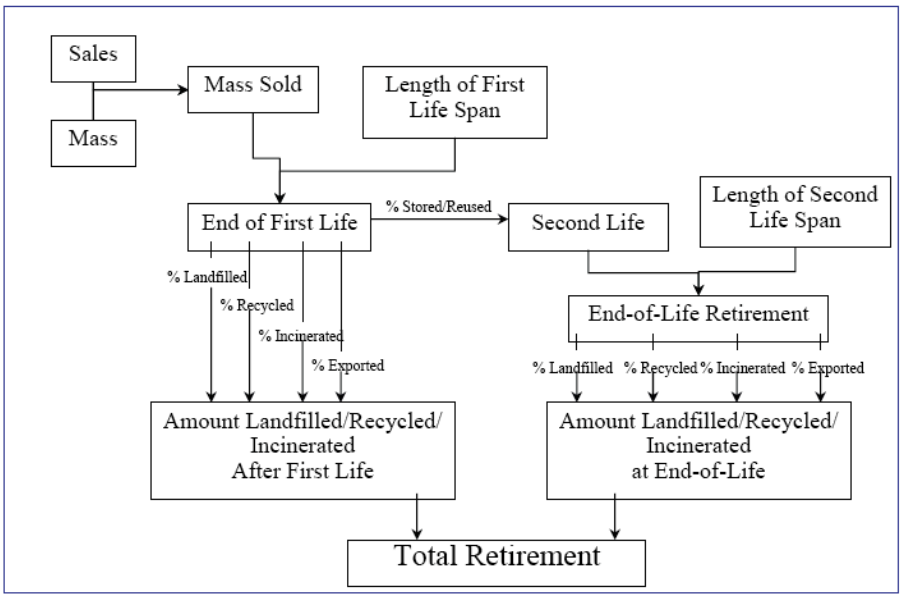


Figure 4-1. Electronic waste flow model framework (U.S. EPA, 2007)

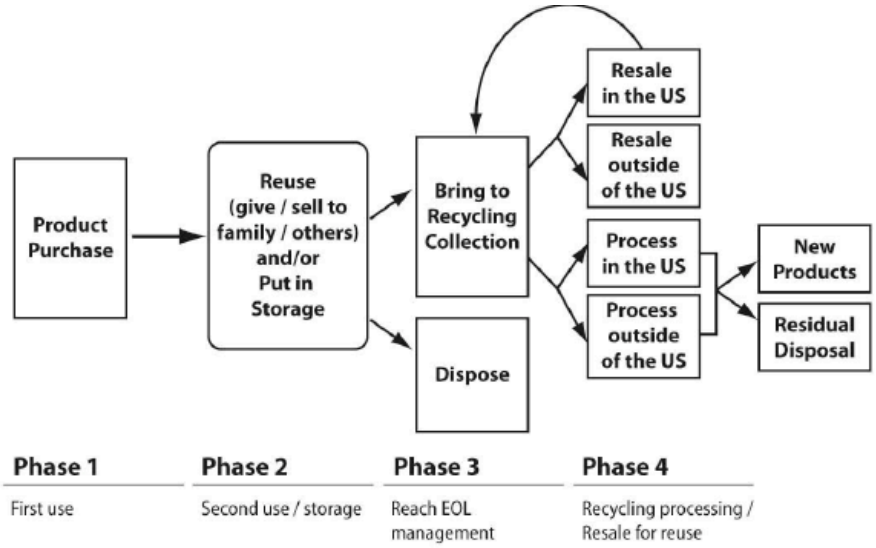


Figure 4-2. Framework for modeling product life cycle (US EPA, 2008)

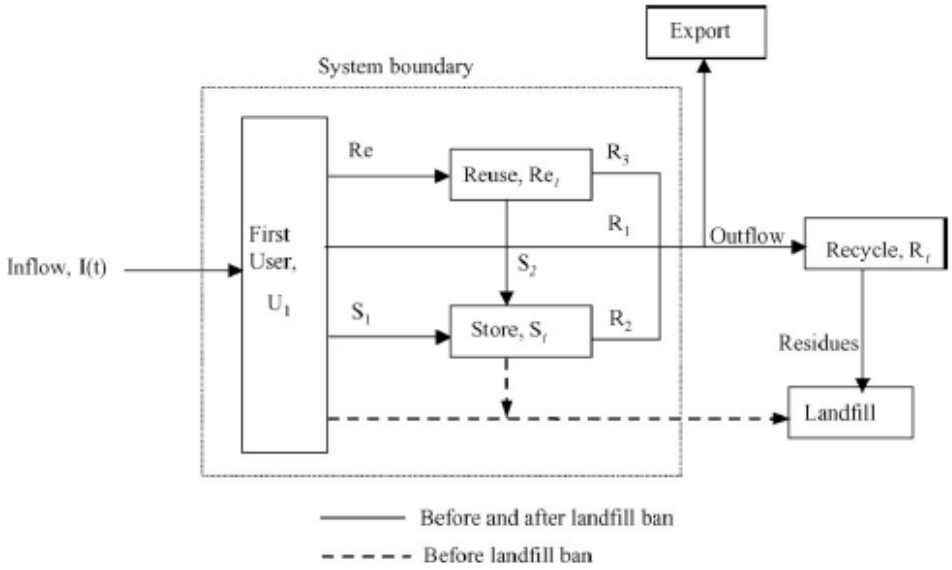


Figure 4-3. Time series electronic waste flow model (Kang and Schoenung, 2006)

4.1 Methodology

A spreadsheet-based model using materials balance and flow modeling and analysis was developed to track the life cycle of CRTs. The overall approach used in the tools is to track CRTs throughout their life cycle, from sales to usage to recycling and disposal. Both CRT televisions as well as CRT computer monitors were included.

Two versions of the spreadsheet model were developed. The primary difference between the two versions is the manner in which the life cycle of the CRT is tracked (compare Figures 1

and 2). Specifically, the duration the product is used, which also is known as the time for the product to reach end-of-life (EOL), was handled differently between the two versions.

- **Split EOL**: This version is based on US EPA (2007) "Approach 2" in which two EOL stages are tracked (Figure 4-4). The model tracks CRTs from when a consumer purchases a monitor or television to when the consumer decides the item is no longer of use. Then the CRT may go into storage or to a second user (from donations or resellers), recycling, incinerator, or landfill, or may be exported. Of the quantity that is reused or stored, the CRT can later be recycled, landfilled, incinerated, or exported; these are second EOL quantities.
- **Lumped EOL**: This version is based on US EPA (2008) "Approach 1" and uses a single set of EOL options. After the consumer is no longer finds the CRT of use, the CRT may be recycled, landfilled, incinerated, and exported. The storage/second use option is not explicitly included and any time a CRT is spent in storage or second use is accounted for in the EOL duration of the CRT.

In both versions, the flow of CRTs was modeled over a 35-year period, from 1985-2020. In the spreadsheet model, a single "sheet" (or tab) contains the calculations for an individual year. Calculations from one year are carried forth to future years in the flow analysis. The spreadsheet models were designed to provide the user with suggested input data; however, values may be customized to the user's needs by inputting new values in any of the gray-shaded cells in the spreadsheet. Both versions of the model use much of the same default suggested data. Details of the two methodologies are described in the following subsections.

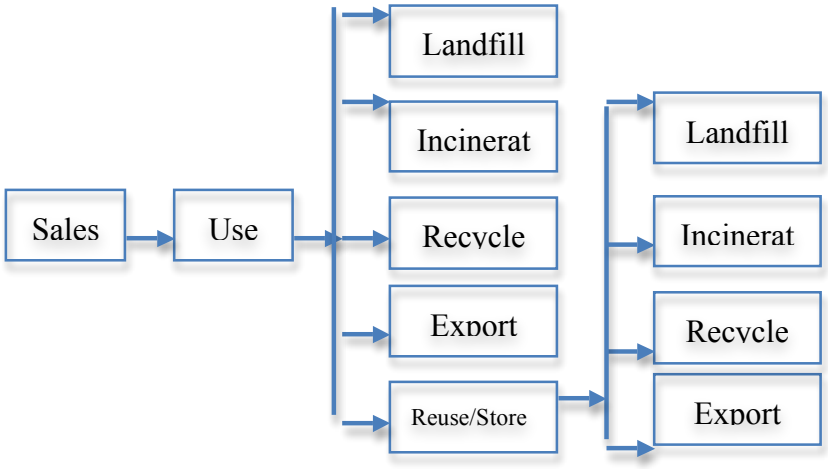


Figure 4-4. CRT flow implemented in the Split EOL model.

4.1.1 Split EOL Methodology

This two EOL cycle version of the CRT flow model was developed following methodology described here. The default input data and implementation into the spreadsheet tool also are detailed.

1. *Initial total quantities*: The fundamental data for the model is estimates on the existing number of CRT television sets and computer monitors. US EPA (2007, 2008) estimated disposal rates of electronics in the U.S. using data from two sources, market research data for sales and government statistics for sales, and found that resulting estimates are similar. CRT data for televisions less 19" and greater than 19" in size and for computer monitors were used to determine the total CRT quantities. Government sales data from US EPA (2008, Tables 2.1 and 2.2) expressed as unit quantities, which is available for the period 1980-2007, was used as the default input data for this model. The unit quantities are converted to total mass (millions of tons) using the average weights of each CRT type based on US EPA (2008, Tables 2.6 and 2.7), which is available for 1980-2007 (Figure 4-5). For the years in which sales and average weight data was not available or projections are needed, in particular 2008-2020, a conservative estimate using the 2007 data was applied as the default input data.

2. *Scaling the quantities*: The CRT quantities calculated in step 1 are scaled to the region of interest. Since the default data used to estimate quantities are for the U.S. overall, a scaling factor to represent Florida's share of the US economy, based on the state's share of the GDP each year, was used as the default value (Figure 4-5). This scaling factor can be changed to reflect the application of the model for another region.

3. *First EOL duration distribution*: The EOL duration represents the time that a CRT product is used before it is no longer of value for the user, or reaches the end-of-life (EOL). Different EOL duration distributions may be used for TV and computer monitor CRTs (Figure 4-6). The model allows for different distributions each year as well. The model provides suggested default values for the above described input data but also allows for the user to change any or all of the information. The default first EOL duration distributions are based on data from US EPA (2007, Exhibit 3-5), which has different distributions for monitors and TVs. For monitors sold between 1990-2004, it is assumed that the EOL duration is 4 years, and for TVs sold between 1975-2004, the EOL duration is 7-13 years. The EOL duration distributions then is used to track the quantity of monitor and TV CRTs sold in a particular year that will reach EOL in future years, thus adding to the cumulative total of CRTs reaching first EOL for any given year (Figure 4-5).

4. *CRT quantities reaching first EOL*: The total mass of CRT monitors and TVs that reach the first EOL in a particular year is then sent to five different EOL management options: landfill, recycling, incineration, export, and storage/reuse. The use may alter the percentage for each option for monitors and TVs (Figure 4-6); note that the percentages must total 100% for all five options. The default values are from US EPA (2007, Exhibit 3-13). The percentages are used to calculate the total mass of monitors and TVs reaching first EOL in a given year from products sold during previous years.

5. *Second EOL duration distribution*: The Split EOL model tracks the flow of the CRTs that go to the storage/reuse option during the first EOL with a second set of EOL distributions. The default second EOL duration distributions are based on US EPA (2007, Exhibit 3-6). The second EOL calculations are the same as those described in step 3.

6. *CRT quantities reaching second EOL*: The total mass of monitors and TVs that reach the second EOL from previous years are calculated based on the second EOL duration distributions calculated in step 5. In the second EOL, four options are available for the CRTs once they have reached the end of the second EOL: landfill, recycling, incineration, and export (Figure 4-7). The outflow of this total is based on the percentage distributions for the four options, with the default values from US EPA (2007, Exhibits 3-10 and 3-11).

7. *Total CRT quantities*: The total mass of CRT monitors and TVs in a particular year is estimated from the totals that reach first and second EOL for that year from products sold during previous years. This total is the sum of the first and second EOL totals from steps 4 and 6 (Figure 4-8).

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O
1	FILL ALL GREY BOXES														
2															
3	YEAR =		2010												
4	CRT TV<19"					CRT TV>19"					CRT Monitot				
5	Sell (Millions Unit)	Suggested sell	Unit Wt(pounds)	Unit Wt.(pounds)	Total (Million Ton)	Sell (Millions Unit)	Suggested sell	Unit Wt(Pounds)	Suggested Unit Wt.(pounds)	Total (Million Ton)	Sell (Millions Unit)	Suggested sell	Unit Wt(pounds)	Unit Wt.(pounds)	Total (Million Ton)
6		2.1		41	0.04305		4.2		73	0.1533		1		50.5	0.02525
7															
8	Product sell (National)														
9	CRT Monitor		0.025	Million ton											
10	CRT Television		0.196	Million ton											
11						Suggested Value									
12	Florida's share Of US economy =					5.46%									
13															
14	Product sell (Florida)														
15	CRT Monitor		0.001	Million ton											
16	CRT Television		0.011	Million ton											
17															

2010 2011 2012 2013 2014 2015 2016 2017 2018 2019 2020

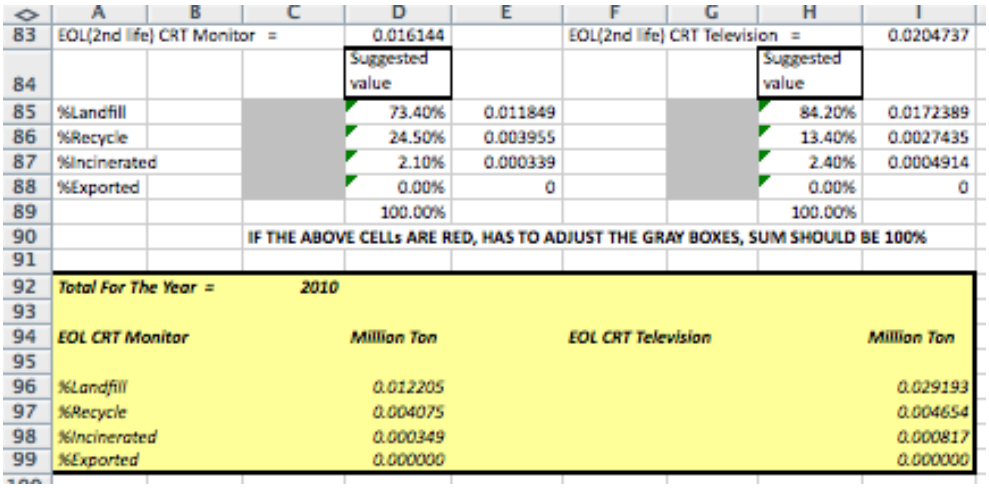
Figure 4-5. Estimating total CRT quantities and weights (Steps 1-2) in the Split EOL model.

	A	B	C	D	E	F	G	H	I	J	K
18	EOL as per distribution (1st life)										
19		CRT Monitor					CRT Television				
20	YEAR	Service Life Probability Distribution	Suggested value	2010	Cumulative Of All Previous Years	Cumulative for that year	Service Life Probability Distribution	Suggested value	2010	Cumulative Of All Previous Years	Cumulative for that year
21	2010		0.00%	0.000000	0.001374	0.001374		0.00%	0.000000	0.040660	0.040660
22	2011		0.00%	0.000000	0.001346	0.001346		0.00%	0.000000	0.041130	0.041130
23	2012		0.00%	0.000000	0.001364	0.001364		0.00%	0.000000	0.040594	0.040594
24	2013		100.00%	0.001379	0.000000	0.001379		0.00%	0.000000	0.038230	0.038230
25	2014		0.00%	0.000000	0.000000	0.000000		0.00%	0.000000	0.034128	0.034128
26	2015		0.00%	0.000000	0.000000	0.000000		0.00%	0.000000	0.027140	0.027140
27	2016		0.00%	0.000000	0.000000	0.000000		5.00%	0.000536	0.018594	0.019130
28	2017		0.00%	0.000000	0.000000	0.000000		10.00%	0.001072	0.012506	0.013578
29	2018		0.00%	0.000000	0.000000	0.000000		20.00%	0.002144	0.007901	0.010045
30	2019		0.00%	0.000000	0.000000	0.000000		30.00%	0.003216	0.003701	0.006917
31	2020		0.00%	0.000000	0.000000	0.000000		20.00%	0.002144	0.001584	0.003728
32	2021		0.00%	0.000000	0.000000	0.000000		10.00%	0.001072	0.000530	0.001602
33	2022		0.00%	0.000000	0.000000	0.000000		5.00%	0.000536	0.000000	0.000536
34	2023		0.00%	0.000000	0.000000	0.000000		0.00%	0.000000	0.000000	0.000000
35	2024		0.00%	0.000000	0.000000	0.000000		0.00%	0.000000	0.000000	0.000000
36	2025		0.00%	0.000000	0.000000	0.000000		0.00%	0.000000	0.000000	0.000000
37	2026		0.00%	0.000000		0.000000		0.00%	0.000000		0.000000
38			100.00%					100.00%			
39	**YEAR =**	**2010**			**IF THE ABOVE CELLs ARE RED, HAS TO ADJUST THE GRAY BOXES, SUM SHOULD BE 100%**						
40	EOL(1st life) CRT Monitor =			0.001374		EOL(1st life) CRT Television =			0.0406595		
41				Suggested value				Suggested value			
42	%Landfill			25.90%	0.00			29.40%	0.0119539		
43	%Recycle			8.70%	0.00			4.70%	0.001911		
44	%Incinerated			0.70%	0.00			0.80%	0.0003253		
45	%Exported			0.00%	0.00			0.00%	0		
46	%Stored/Reused			64.70%	0.00			65.10%	0.0264693		
47		**SUM =**		100.00%				100.00%			
48			**IF THE ABOVE CELLs ARE RED, HAS TO ADJUST THE GRAY BOXES, SUM SHOILD BE 100%**								

Figure 4-6. First EOL duration distributions in the Split EOL model.

	A	B	C	D	E	F	G	H	I	J	K
49	EOL as per distribution (2nd life)										
50		CRT Monitor					CRT Television				
51	YEAR	Service Life Probability Distribution	Suggested Vlue	2010	Cumulative Of All Previous Years	Cumulative for that year	Service Life Probability Distribution	Suggested Vlue	2010	Cumulative Of All Previous Years	Cumulative for that year
52	2010		0.00%	0.000000	0.016144	0.016144		0.00%	0.000000	0.020474	0.020474
53	2011		3.70%	0.000033	0.015326	0.015359		9.20%	0.002435	0.019011	0.021447
54	2012		5.40%	0.000048	0.013852	0.013900		6.80%	0.001800	0.018078	0.019878
55	2013		7.40%	0.000066	0.012025	0.012091		9.40%	0.002488	0.016348	0.018836
56	2014		9.30%	0.000083	0.010408	0.010490		7.30%	0.001932	0.015040	0.016973
57	2015		7.10%	0.000063	0.008798	0.008861		9.00%	0.002382	0.013164	0.015546
58	2016		8.00%	0.000071	0.007405	0.007476		6.70%	0.001773	0.011801	0.013574
59	2017		10.00%	0.000089	0.005953	0.006042		6.80%	0.001800	0.010346	0.012146
60	2018		10.00%	0.000089	0.004875	0.004963		5.90%	0.001562	0.009093	0.010655
61	2019		9.10%	0.000081	0.004063	0.004144		3.80%	0.001006	0.008369	0.009375
62	2020		4.90%	0.000044	0.003532	0.003576		5.70%	0.001509	0.007101	0.008609
63	2021		4.70%	0.000042	0.003097	0.003138		6.40%	0.001694	0.005595	0.007289
64	2022		2.80%	0.000025	0.002647	0.002672		4.60%	0.001218	0.004518	0.005735
65	2023		4.00%	0.000036	0.002125	0.002160		4.70%	0.001244	0.003380	0.004624
66	2024		2.30%	0.000020	0.001719	0.001739		3.90%	0.001032	0.002432	0.003464
67	2025		1.40%	0.000012	0.001314	0.001326		2.60%	0.000688	0.001812	0.002500
68	2026		2.00%	0.000018	0.000934	0.000951		2.30%	0.000609	0.001252	0.001861
69	2027		1.10%	0.000010	0.000634	0.000644		2.50%	0.000662	0.000620	0.001282
70	2028		1.50%	0.000013	0.000365	0.000378		1.40%	0.000371	0.000262	0.000632
71	2029		2.70%	0.000024	0.000198	0.000222		1.00%	0.000265	0.000000	0.000265
72	2030		0.90%	0.000008	0.000097	0.000105		0.00%	0.000000	0.000000	0.000000
73	2031		0.60%	0.000005	0.000035	0.000040		0.00%	0.000000	0.000000	0.000000
74	2032		1.10%	0.000010	0.000000	0.000010		0.00%	0.000000	0.000000	0.000000
75	2033		0.00%	0.000000	0.000000	0.000000		0.00%	0.000000	0.000000	0.000000
76	2034		0.00%	0.000000	0.000000	0.000000		0.00%	0.000000	0.000000	0.000000
77	2035		0.00%	0.000000	0.000000	0.000000		0.00%	0.000000	0.000000	0.000000
78	2036		0.00%	0.000000	0.000000	0.000000		0.00%	0.000000	0.000000	0.000000
79	2037		0.00%	0.000000		0.000000		0.00%	0.000000		0.000000
80			100.00%					100.00%			
81	YEAR =	2010			IF THE ABOVE CELLs ARE RED, HAS TO ADJUST THE GRAY BOXES, SUM SHOULD BE 100%						
82											
83	EOL(2nd life) CRT Monitor =			0.016144		EOL(2nd life) CRT Television =			0.0204737		
84				Suggested value				Suggested value			
85	%Landfill			73.40%	0.011849			84.20%	0.0172389		
86	%Recycle			24.50%	0.003955			13.40%	0.0027435		
87	%Incinerated			2.10%	0.000339			2.40%	0.0004914		
88	%Exported			0.00%	0			0.00%	0		
89				100.00%				100.00%			
90			IF THE ABOVE CELLs ARE RED, HAS TO ADJUST THE GRAY BOXES, SUM SHOULD BE 100%								

Figure 4-7. Second EOL duration distributions in the Split EOL model.



	A	B	C	D	E	F	G	H	I
83	EOL(2nd life) CRT Monitor =			0.016144		EOL(2nd life) CRT Television =			0.0204737
84				Suggested value				Suggested value	
85	%Landfill			73.40%	0.011849			84.20%	0.0172389
86	%Recycle			24.50%	0.003955			13.40%	0.0027435
87	%Incinerated			2.10%	0.000339			2.40%	0.0004914
88	%Exported			0.00%	0			0.00%	0
89				100.00%				100.00%	
90			IF THE ABOVE CELLs ARE RED, HAS TO ADJUST THE GRAY BOXES, SUM SHOULD BE 100%						
91									
92	*Total For The Year =*		*2010*						
93									
94	*EOL CRT Monitor*			*Million Ton*		*EOL CRT Television*			*Million Ton*
95									
96	*%Landfill*			*0.012205*					*0.029193*
97	*%Recycle*			*0.004075*					*0.004654*
98	*%Incinerated*			*0.000349*					*0.000817*
99	*%Exported*			*0.000000*					*0.000000*

Figure 4-8. Total mass of CRTs that are estimated to reach EOL in the Split EOL model.

4.1.2 Lumped EOL Methodology

This single EOL cycle version of the CRT flow model was developed following methodology described here. The default input data and implementation into the spreadsheet tool also are detailed.

1. *Initial total quantities*: The fundamental data for the model is estimates on the existing number of CRT television sets and computer monitors. CRT data for televisions less 19" and greater than 19" in size and for computer monitors were used to determine the total CRT quantities. Government sales data from US EPA (2008, Tables 2.1 and 2.2) expressed as unit quantities, which is available for the period 1980-2007, was used as the default input data for this model. The unit quantities are converted to total mass (millions of tons) using the average weights of each CRT type based on US EPA (2008, Tables 2.6 and 2.7), which is available for 1980-2007. For the years in which sales and average weight data was not available or projections are needed, in particular 2008-2020, a conservative estimate using the 2007 data was applied as the default input data. This is the same initial default input data used in the Split EOL version of the CRT flow model.
2. *Scaling the quantities*: The CRT quantities calculated in step 1 are scaled to the region of interest, just as was done in the Split EOL version. Since the default data used to estimate quantities are for the U.S. overall, a scaling factor to represent Florida's share of the US economy, based on the state's share of the GDP each year, was used as the default value. This scaling factor can be changed to reflect the application of the model for another region.
3. *EOL duration distribution*: The EOL duration represents the time that a CRT product is used before it is no longer of value for the user, or reaches the end-of-life (EOL). Different EOL duration distributions may be used for TV and computer monitor CRTs (Figure 4-9). The model allows for different distributions each year as well. The model provides suggested default values for the above described input data but also allows for the user to change any or all of the information. The default EOL duration

distributions are based on data from US EPA (2008, Tables 2.3 and 2.4), which has different distributions for monitors and TVs. For monitors sold between 1990-2004, it is assumed that the EOL duration is 4 years, and for TVs sold between 1975-2004, the EOL duration is 7-13 years. The EOL duration distributions then is used to track the quantity of monitor and TV CRTs sold in a particular year that will reach EOL in future years, thus adding to the cumulative total of CRTs reaching first EOL for any given year (Figure 4-9).

4. *CRT quantities reaching EOL*: The total mass of CRT monitors and TVs that reach the first EOL in a particular year is then sent to four different EOL management options: landfill, recycling, incineration, and export. The use may alter the percentage for each option for monitors and TVs (Figure 4-9); note that the percentages must total 100% for all four options. The percentages are used to calculate the total mass of monitors and TVs reaching EOL in a given year from products sold during previous years. The outflow of this total is based on the percentage distributions for the four options, with the default values from US EPA (2007, Exhibits 3-10 and 3-11).

5. *Total CRT quantities*: The total mass of CRT monitors and TVs in a particular year is estimated from the totals that reach EOL for that year from products sold during previous years, resulting from step 4 (Figure 4-10).

	A	B	C	D	E	F	G	H	I	J	K
18	EOL as per distribution										
19			CRT Monitor					CRT television			
20	YEAR	Service Life Probability Distribution	Suggested Value	2010	Cumulative Of All Previous Years	Cumulative for that year	Service Life Probability Distribution	Suggested Value	2010	Cumulative Of All Previous Years	Cumulative for that year
21	2010		0.00%	0.0000	0.0173	0.0173		0.00%	0.0000	0.0348	0.0348
22	2011		0.00%	0.0000	0.0132	0.0132		0.00%	0.0000	0.0354	0.0354
23	2012		0.00%	0.0000	0.0117	0.0117		0.00%	0.0000	0.0362	0.0362
24	2013		20.80%	0.0003	0.0100	0.0103		0.00%	0.0000	0.0357	0.0357
25	2014		0.00%	0.0000	0.0075	0.0075		0.00%	0.0000	0.0327	0.0327
26	2015		43.20%	0.0006	0.0051	0.0056		0.00%	0.0000	0.0314	0.0314
27	2016		0.00%	0.0000	0.0032	0.0032		0.00%	0.0000	0.0314	0.0314
28	2017		0.00%	0.0000	0.0025	0.0025		14.00%	0.0015	0.0307	0.0322
29	2018		12.00%	0.0002	0.0015	0.0016		11.00%	0.0012	0.0279	0.0291
30	2019		0.00%	0.0000	0.0008	0.0008		0.00%	0.0000	0.0247	0.0247
31	2020		12.00%	0.0002	0.0002	0.0003		0.00%	0.0000	0.0224	0.0224
32	2021		0.00%	0.0000	0.0002	0.0002		0.00%	0.0000	0.0210	0.0210
33	2022		0.00%	0.0000	0.0002	0.0002		14.00%	0.0015	0.0174	0.0189
34	2023		12.00%	0.0002	0.0000	0.0002		11.00%	0.0012	0.0153	0.0165
35	2024		0.00%	0.0000	0.0000	0.0000		0.00%	0.0000	0.0126	0.0126
36	2025		0.00%	0.0000	0.0000	0.0000		14.00%	0.0015	0.0114	0.0129
37	2026		0.00%	0.0000	0.0000	0.0000		0.00%	0.0000	0.0101	0.0101
38	2027		0.00%	0.0000	0.0000	0.0000		11.00%	0.0012	0.0059	0.0071
39	2028		0.00%	0.0000	0.0000	0.0000		0.00%	0.0000	0.0058	0.0058
40	2029		0.00%	0.0000	0.0000	0.0000		0.00%	0.0000	0.0049	0.0049
41	2030		0.00%	0.0000	0.0000	0.0000		14.00%	0.0015	0.0012	0.0027
42	2031		0.00%	0.0000	0.0000	0.0000		0.00%	0.0000	0.0012	0.0012
43	2032		0.00%	0.0000	0.0000	0.0000		0.00%	0.0000	0.0012	0.0012
44	2033		0.00%	0.0000		0.0000		11.00%	0.0012		0.0012
45			100.00%					100.00%			
46	YEAR =	2010			IF THE ABOVE CELLs ARE RED, HAS TO ADJUST THE GRAY BOXES, SUM SHOILD BE 100%						

2008 2009 2010 2011 2012 2013 2014 2015 2016 2017 2018

Figure 4-9. EOL duration distributions in the Lumped EOL model.

	A	B	C	D	E	F	G	H	I
47	EOL CRT Monitor =			0.0172864		EOL CRT Television =			0.03480024
48									
49				Suggested Value				Suggested Value	
50	%Landfill			73.40%	0.012688			84.20%	0.0293018
51	%Recycle			24.50%	0.004235			13.40%	0.00466323
52	%Incinerated			2.10%	0.00036			2.40%	0.00083521
53	%Exported			0.00%	0.00000			0.00%	0.000000
54				100.00%				100.00%	
55									
56									
57	***Total For The Year =***		***2010***						
58									
59	***EOL CRT Monitor***			***Million Ton***		***EOL CRT Television***			***Million Ton***
60									
61	*%Landfill*			*0.0127*					*0.0293*
62	*%Recycle*			*0.0042*					*0.0047*
63	*%Incinerated*			*0.0004*					*0.0008*
64	*%Exported*			*0.0000*					*0.0000*

Figure 4-10. Total mass of CRTs that are estimated to reach EOL in the Lumped EOL model.

4.2 Results and Discussion

The results using the default input values described in Section 4.1 for both the Split EOL and Lumped EOL versions of the CRT flow model are presented here. These results represent the example base case. The values and trends shown are not intended to be formal predictions of the quantities of CRTs disposed in Florida, and some of the assumed values used for this example problem may not be representative of the actual conditions.

The base case uses the default input data provided in the model, which are based on information reported in the literature. Sales data for CRT computer monitors and TVs (for both units <19" and >19") was from U.S. government statistics for 1985-2007. For the years 2008-2020, it was assumed that sales would be same as for 2007 to provide a conservative, worst-case scenario. The average weight of computer monitors, TVs < 19", and TVs >19" was assumed to be 50.5, 41, and 73 pounds, respectively, during 2004-2020 and varied (typically lower) for 1985-2003; these values are from data found in US EPA (2008). Florida's share of the total U.S. CRT sales was based on published data on the state's share of the US economy for 2004-2008; for 1985-2003 a value of 4.5-5.1% was assumed, and an average based on the previous 5 years' data was used for 2009-2020.

For the Split EOL base case example, the first EOL duration for CRT computer monitors was assumed to 3 years for the entire modeled period and distributed between 6-12 years for CRT TVs; this is based on US EPA (2007). At the first EOL, it was assumed that of the total CRT computer monitors that are disposed during a given year, 25.9% will go to landfills, 8.7% are recycled, 0.7% are incinerated, 0% are exported, and 64.7% are stored or reused. For CRT TVs at the first EOL, it was assumed that 29.4% go to landfills, 4.7% are recycled, 0.8% are incinerated, 0% are exported, and 65.10% are stored or reused. The values for second life (after reuse or storage) are different from those for fist life. The second EOL duration was assumed to be 1-22 years for monitors and 1-19 years for TVs. At the second EOL, 73.4% of

monitors are assumed to be sent to landfills, 24.5% are recycled, and 2.1% are incinerated; for TVs, it was assumed that 84.2% are landfilled, 13.4% are recycled, and 2.4% are incinerated. In the base case example, it is assumed that the EOL durations and disposal distributions are the same for all years of the model. However, the model has the capability to use different input values for each year included in the model.

For the Lumped EOL base case example, the EOL duration for CRT computer monitors was assumed to be distributed between 3-13 years and distributed between 7-23 years for CRT TVs for the entire modeled period; this is based on US EPA (2008). At the EOL, it was assumed that of the total CRT computer monitors that are disposed during a given year, 73.4% will go to landfills, 24.5% are recycled, 2.1% are incinerated, and 0% is exported. For CRT TVs at the EOL, it was assumed that 84.2% go to landfills, 13.4% are recycled, 2.4% are incinerated, and 0% is exported.

Figure 4-11 summarizes the total weights (in thousands of tons) of CRT computer monitors and TVs that would be disposed and processed through all options during 2005-2020 for the example base case. Because the amount of CRT computer monitors sold has decreased in recent years, it is expected that less will be seen in the waste stream. The total weight of CRT TVs disposed is larger than that of CRT monitors for this period, especially during later years. This is due to the decline in the number of CRT monitors sold occurring earlier than for CRT TVs. The trends in CRT quantities during this period are similar for both the Split EOL and Lumped EOL models. However, the Lumped EOL model predicts more TVs during 2016-2020 and fewer monitors during 2011-2020 compared to the Split EOL model (Figure 4-11). The differences are due to the EOL durations used in the two versions of the model, since the initial sales quantities are the same for both versions. The differences in the overall EOL distributions are due to the differences in the accumulated durations based on previous years' age distribution. For example, the total amount of CRT TVs estimated by the Split EOL model during 2017 is 27,000 tons, compared to 32,000 tons estimated by the Lumped EOL model. The age distribution of CRT TVs in 2017 shown in Table 4-1 shows that the majority of TVs in the waste stream during that year occurs from 2006 to 2011 for the Split EOL version while majority occurs from 1994 to 2010 in the Lumped EOL model. Figure 4-12 shows the total sales CRT TVs and monitors from data in US EPA (2008), which indicates the total sales TVs dropped significantly in 2007.

Figures 4-13 and 4-14 show the weights of CRT monitors and TVs that would be recycled and sent to the landfill, respectively, based on the default input values described in Section 4.1. The trend for the amount of CRTs recycled and landfilled is similar to the total amounts. Similar differences between the Split EOL and Lumped EOL models for these management options (Figures 4-13 and 4-14) also are similar to that for the total waste stream (Figure 4-11).

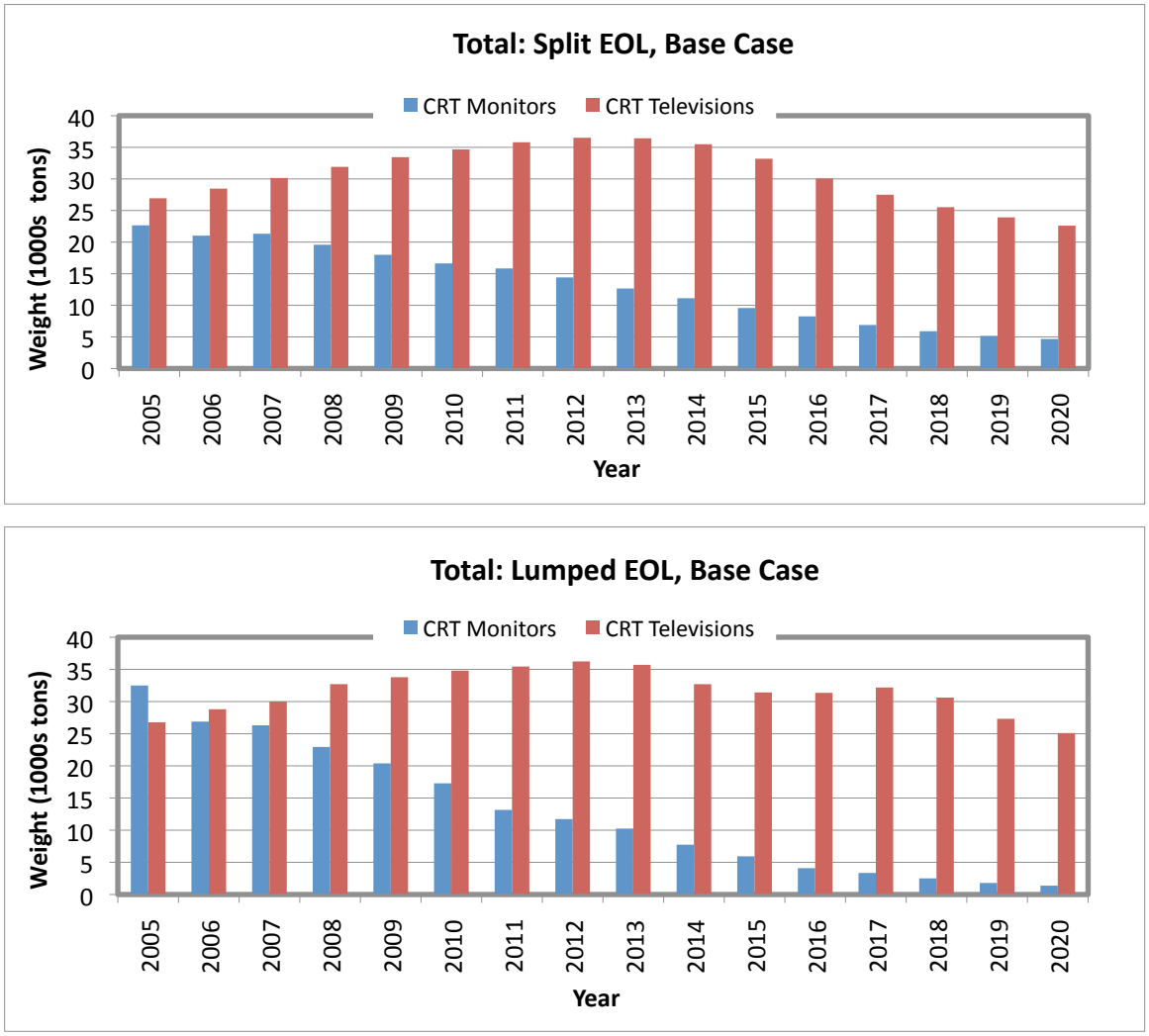


Figure 4-11. Base case results for total weight of CRTs disposed to all waste streams.

Table 4-1. Sample age distribution of CRT TVs in 2017 for the Split EOL and Lumped EOL models.

Year	Split EOL (%)	Lumped EOL (%)
1994	-	11
1995	-	-
1996	-	-
1997	-	14
1998	-	-
1999	0.9	-
2000	1.6	11
2001	1.5	-
2002	1.7	14
2003	2.5	-
2004	3	11
2005	8.06	14
2006	14.17	-
2007	23.71	-
2008	32.47	-
2009	23.84	11
2010	14.43	14
2011	9.36	-
2012	5.9	-
2013	4.8	-
2014	6.1	-
2015	4.4	-
2016	6	-

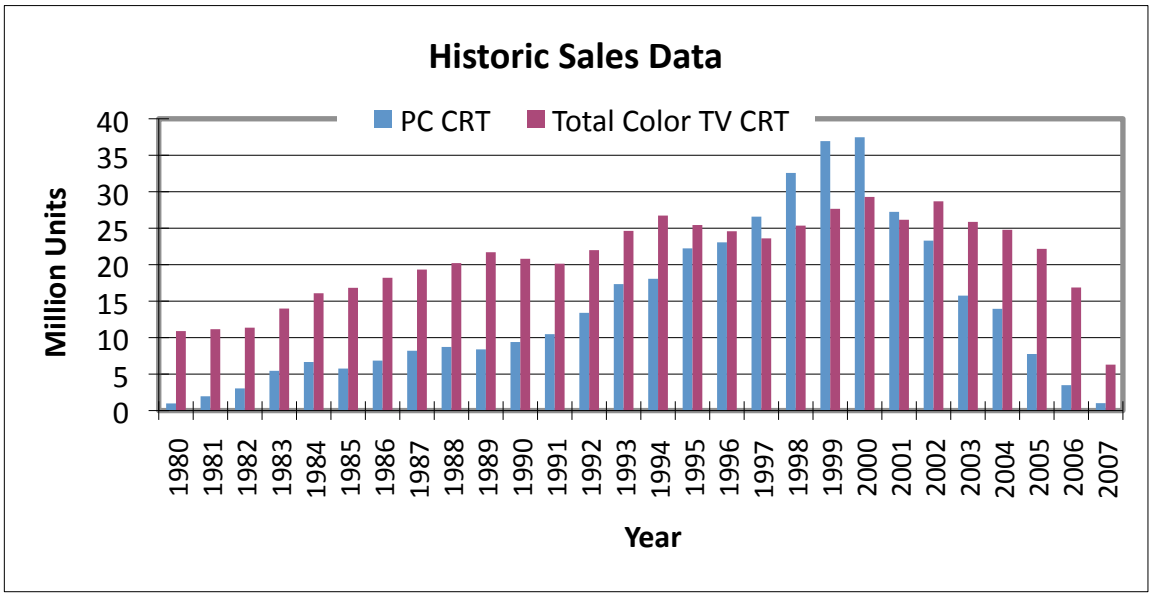


Figure 4-12. Historic national sales data for CRT monitors and TVs (from US EPA, 2008).

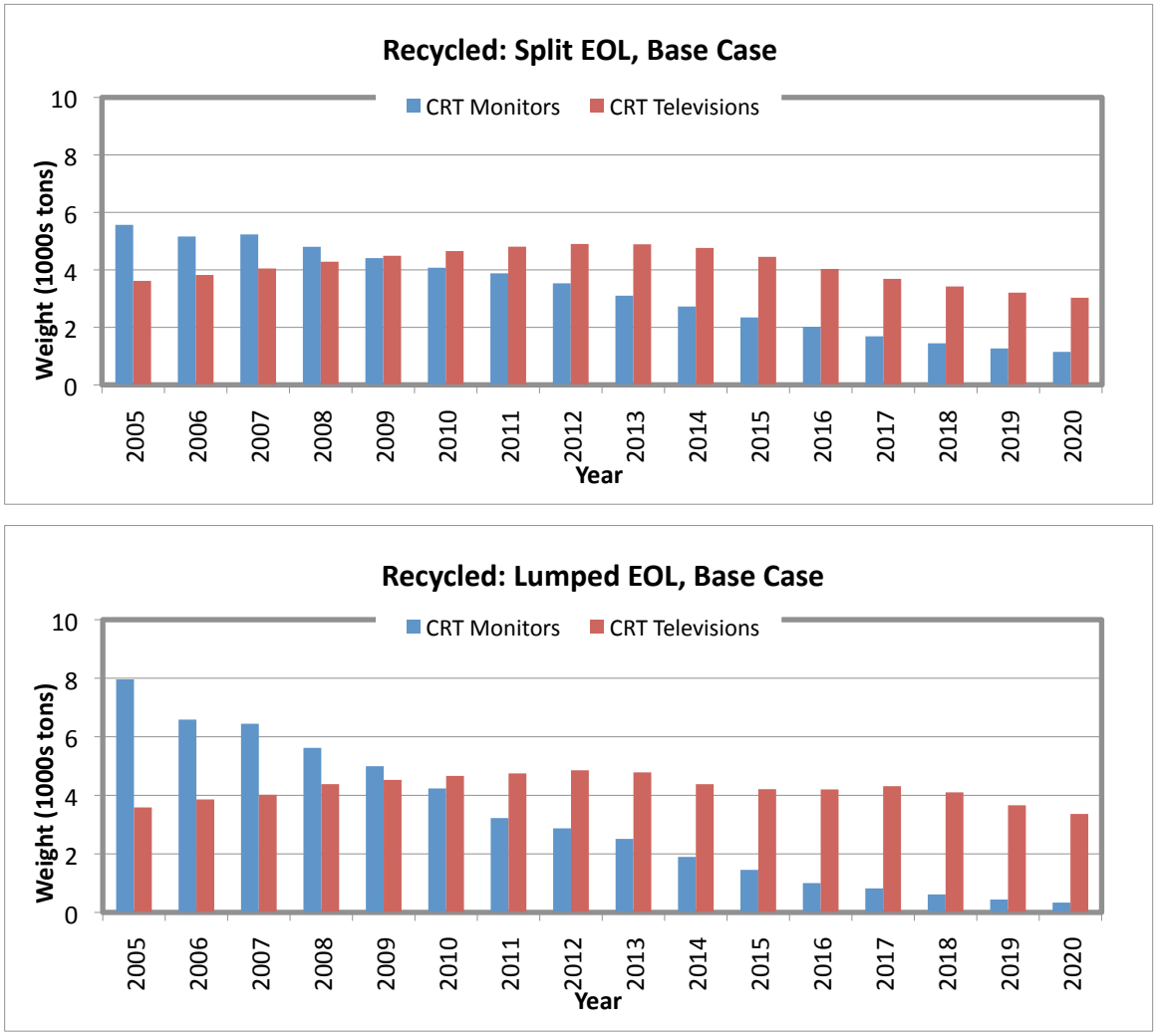


Figure 4-13. Base case results of the weight of CRTs recycled.

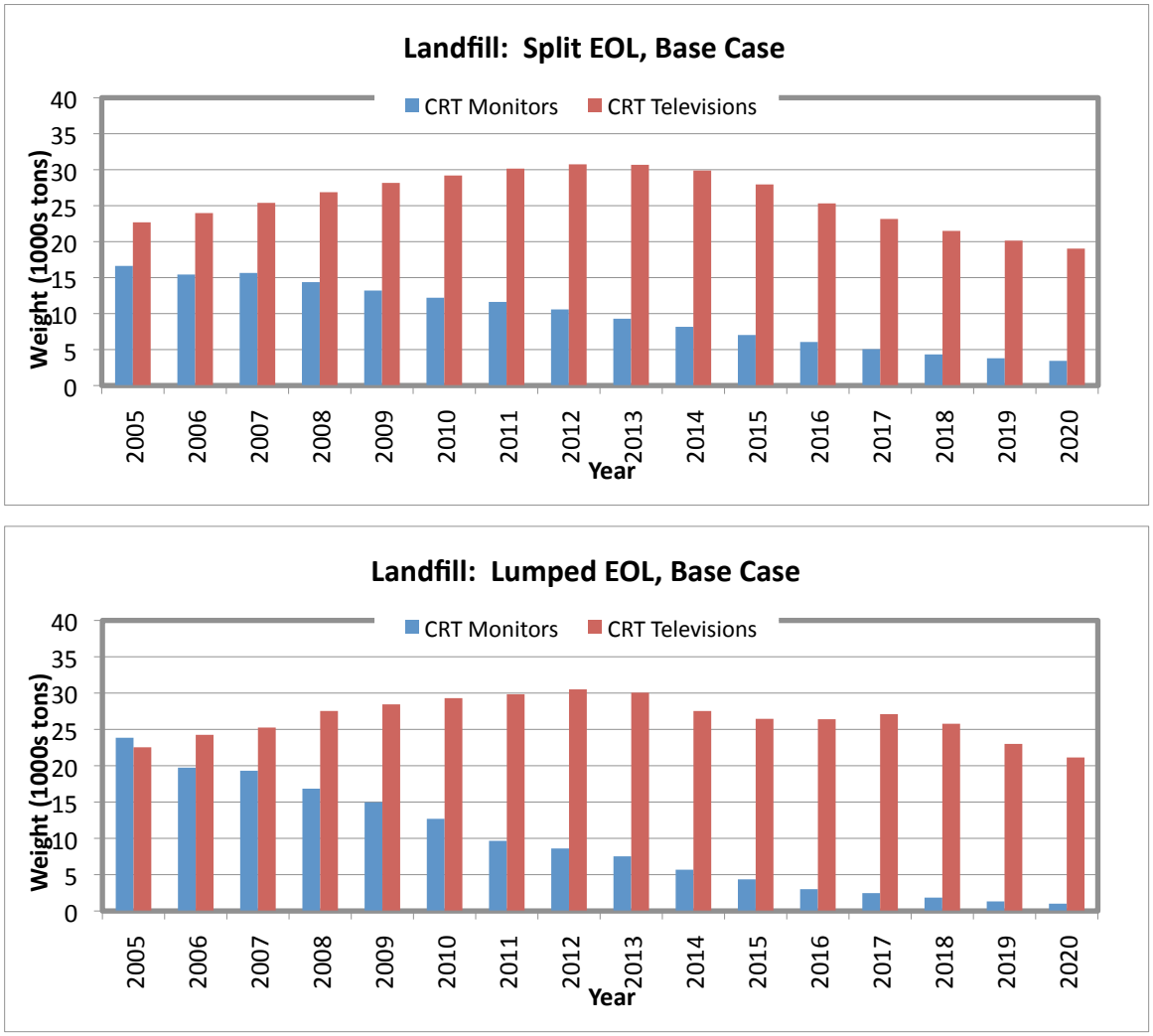


Figure 4-14. Base case results of the weight of CRTs sent to landfills.

4.3 Model Verification

The Split EOL version of the CRT flow model was applied to a case study for model verification purposes. Broward County was selected because of the extent of data available from the county HHW manager surveys. The results of the Split EOL model were compared to the reported data from the county HHW manager surveys (Appendix C).

Rather than modeling the flow of CRTs estimated for the entire state of Florida, sales quantities were scaled to represent Broward County's share based on population. Based on census and population data from July 1, 2008 (US Census Bureau, 2009), the population was 18,328,340 for the state of Florida and 1,751,234 for Broward County. Based on this, Broward County accounted for 9.6% of the state's total population; this factor is used to scale the CRT sales data. All of the default input values were used in this case study.

The computer monitor and TV CRTs reported in the county HHW manager surveys for 2007, 2008, and 2009 were compared to the calculated results from the split EOL version of the

CRT flow model (Table 4-2). The model overestimates the CRT quantities, expressed as total weight, by a factor of 10 to 12 for monitors and 22 to 36 for TVs during these three years. The trends during this period are not consistent between the survey responses and model. Several issues may help explain the difference between the two sources of estimates. One explanation may be that the surveys do not capture the total quantities. Another is that a county's population may not be a representative estimation for CRT sales compared to the rest of the state or nation, especially given that Broward county is the second most populous in Florida out of its 69 counties. In addition, the EOL duration distributions, especially for TVs, may not be reflective of the true nature of disposal in Broward County. Nonetheless, it was expected that the CRT flow model, based on the default input values, would not precisely predict the quantities reported in the survey, but only provide rough estimates. As such, if more county-specific input data were used, which was not available, it is expected that the model results would be more similar to the survey responses.

Table 4-2. Comparison of survey and Split EOL model results for the Broward County case study. All quantities are expressed in thousands of tons of CRTs.

	2007		**2008**		**2009**	
	Monitors	**TVs**	**Monitors**	**TVs**	**Monitors**	**TVs**
Survey Response	0.165	0.097	0.166	0.136	0.170	0.088
Split EOL Model	2.05	2.83	1.88	3.00	1.73	3.16

5. Task 3: Analyze management options

The CRT flow analysis models developed in Task 2 were used to explore potential management policies. This task provides answers to the questions: "How can the current practices in Florida for CRT disposal management be improved?" and "What are the potential effects of management policies on the CRT waste stream?" The models also allow managers and policy makers to compare different CRT waste stream and disposal option scenarios.

We analyzed different scenarios to identify the effects of disposal management practices and policies on the CRT quantities and flow. These scenarios are based on hypothetical infrastructure constraints (such as facility capacity and population behavior on estimation) and potential policy constraints (such as potential disposal restrictions). In particular, we modeled scenarios that vary the distribution to the different disposal options.

5.1 Methodology

This task applies the spreadsheet-based models developed in Task 2. This management tool has the ability to analyze different management options and scenarios. Some of these scenarios are based on potential legislative requirements (such as banning the disposal of CRTs in landfills or requiring a specified recycling rate). The CRT life cycle includes consumer usage, storage, demanufacturing and processing, recycling domestically, shipping CRTs overseas, landfill disposal, and reuse by a second user.

The following management options were analyzed and compared:

1. Existing waste stream and infrastructure options based on current data (data from Task 2). This scenario is included to provide a baseline case for comparison against other scenarios (Cases 1S and 1L).
2. Disposal of CRTs in landfills is banned and 50% of CRTs must be recycled (Cases 2S and 2L).
3. Disposal of CRTs in landfills is banned and 50% of CRTs are sent overseas (Cases 3S and 3L). Estimates indicate that 50-80% of the e-scrap collected in countries that have not ratified the Basel Ban, including the United States, is shipped internationally to counties such as China and India (Puckett and Smith, 2002).
4. Disposal of CRTs is allowed in landfills, 25% of CRTs are recycled, and 25% of CRTs are sent overseas (Cases 4S and 4L).
5. Disposal of CRTs is allowed in landfills, 20% of CRTs are recycled, and 10% of CRTs are sent overseas (Cases 5S and 5L)
6. Disposal of CRTs in landfills is banned and 75% of CRTs must be recycled (Cases 6S and 6L).
7. Small (5%) amount of CRTs allowed in landfills and 75% of CRTs must be recycled (Cases 7S and 7L).

A total of eleven management options (cases) were evaluated using the Split EOL model and seven cases were evaluated using the Lumped EOL model. Some of these cases were

developed in consultation of the Technical Awareness Group (TAG), while others were used for sensitivity analysis. Table 5.1 summarizes the percent distributions among the first and second EOL disposal options used in the cases evaluated with the Split EOL model. Because of the two EOL life cycles tracked in the Split EOL model, the overall cumulative percent distribution of CRTs sent to the available final disposal options (landfill, recycle, incinerate, export) is the sum of the percentage from the first EOL cycle and the percentage of CRTs that is stored or reused during the first EOL that later goes to the same disposal option during the second EOL. Table 5.2 summarizes the cumulative percentages for the disposal options based on the first and second EOL distributions detailed in Table 5.1 for the Split EOL cases evaluated. Some of the cases (6L-11L) evaluated using the Split EOL model provided sensitivity analysis related to prohibiting CRT disposal in landfills and/or require recycling or explore other options. The details of the cases evaluated using the Lumped EOL model is summarized in Table 5.3. Note that cases 1S-7S using the Split EOL model use the same overall percentages for the disposal options as cases 1L-7L using the Lumped EOL model. In these scenarios, the portion that is incinerated remains the same, 2.1% for monitors and 2.4% for TVs, based on data from US EPA (2007). Cases 1S and 1L represent the base cases using the default input data described in Section 4.1, and the results of which are discussed in Section 4.2.

Table 5-1. Details of the management options analyzed using the Split EOL model (PC = CRT computer monitors, TV = CRT televisions).

	First EOL (%)										Second EOL (%)							
	Landfill		Recycle		Incinerate		Export		Store/ Reuse		Landfill		Recycle		Incinerate		Export	
Case	PC	TV	PC	TV	PC	TV	PC	TV	PC	TV	PC	TV	PC	TV	PC	TV	PC	TV
1S	25.9	29.4	8.7	4.7	0.7	0.8	0.0	0.0	64.7	65.1	73.4	84.2	24.5	13.4	2.1	2.4	0.0	0.0
2S	0.0	0.0	17.7	17.5	0.7	0.8	16.9	16.6	64.7	65.1	0.0	0.0	50.0	50.0	2.1	2.4	47.9	47.6
3S	0.0	0.0	16.9	16.6	0.7	0.8	17.7	17.5	64.7	65.1	0.0	0.0	47.9	47.6	2.1	2.4	50.0	50.0
4S	16.9	16.6	8.8	8.7	0.7	0.8	8.8	8.7	64.7	65.1	47.9	47.6	25.0	25.0	2.1	2.4	25.0	25.0
5S	24.0	23.6	7.1	7.0	0.7	0.8	3.5	3.5	64.7	65.1	67.9	67.6	20.0	20.0	2.1	2.4	10.0	10.0
6S	0.0	0.0	26.5	26.2	0.7	0.8	8.1	7.9	64.7	65.1	0.0	0.0	75.0	75.0	2.1	2.4	22.9	22.6
7S	1.8	1.7	26.5	26.2	0.7	0.8	6.3	6.1	64.7	65.1	5.0	5.0	75.0	75.0	2.1	2.4	17.9	17.6
8S	0.0	0.0	50.0	50.0	0.7	0.8	0.0	0.0	49.3	49.2	0.0	0.0	50.0	50.0	2.1	2.4	47.9	47.6
9S	0.0	0.0	8.7	4.7	0.7	0.8	50.0	50.0	40.6	44.5	0.0	0.0	47.9	47.6	2.1	2.4	50.0	50.0
10S	0.0	0.0	25.0	25.0	0.7	0.8	25.0	25.0	49.3	49.2	47.9	47.6	25.0	25.0	2.1	2.4	25.0	25.0
11S	0.0	0.0	20.0	20.0	0.7	0.8	10.0	10.0	69.3	69.2	67.9	67.6	20.0	20.0	2.1	2.4	10.0	10.0

Table 5-2. Management options (cumulative distribution after first and second EOL) analyzed using the Split EOL model. All values are expressed as percentages of total CRT disposed.

	Landfill (%)		Recycle (%)		Incinerate		Export (%)	
Case	**PC**	**TV**	**PC**	**TV**	**PC**	**TV**	**PC**	**TV**
1S (base)	73.4	84.2	24.6	13.4	2.1	2.4	0.0	0.0
2S	0.0	0.0	50.0	50.0	2.1	2.4	47.9	47.6
3S	0.0	0.0	47.9	47.6	2.1	2.4	50.0	50.0
4S	47.9	47.6	25.0	25.0	2.1	2.4	25.0	25.0
5S	67.9	67.6	20.0	20.0	2.1	2.4	10.0	10.0
6S	0.0	0.0	75.0	75.0	2.1	2.4	22.9	22.6
7S	5.0	5.0	75.0	75.0	2.1	2.4	17.9	17.6
8S	0.0	0.0	74.7	74.6	1.7	2.0	23.6	23.4
9S	0.0	0.0	8.9	25.9	1.6	1.9	70.3	72.3
10S	23.6	23.4	37.3	37.3	1.7	2.0	37.3	37.3
11S	47.1	46.8	33.9	33.8	2.2	2.5	16.9	16.9

Table 5-3. Management options analyzed using the Lumped EOL model. All values are expressed as percentages of total CRT disposed.

	Landfill (%)		Recycle (%)		Incinerate		Export (%)	
Case	**PC**	**TV**	**PC**	**TV**	**PC**	**TV**	**PC**	**TV**
1L (base)	73.4	84.2	24.5	13.4	2.1	2.4	0.0	0.0
2L	0.0	0.0	50.0	50.0	2.1	2.4	47.9	47.6
3L	0.0	0.0	47.9	47.6	2.1	2.4	50.0	50.0
4L	47.9	47.6	25.0	25.0	2.1	2.4	25.0	25.0
5L	67.9	67.6	20.0	20.0	2.1	2.4	10.0	10.0
6L	0.0	0.0	75.0	75.0	2.1	2.4	22.9	22.6
7L	5.0	5.0	75.0	75.0	2.1	2.4	17.9	17.6

5.2 Results and Discussion

The complete model results for the base cases, Cases 1S and 1L, are shown in Figures 5-1 and 5-2, respectively. These cases are for the waste stream and infrastructure options based on published data used in Task 2. The variation in the quantity of CRT monitors and TVs, expressed as weight, during 2005-2020 for the total waste stream as well as to the four final management options (landfill, recycle, incinerate, and export) are shown in these figures. These scenarios are included to provide a baseline case for comparison against other scenarios using the Split EOL and Lumped EOL models.

Cases 2S and 2L: The results of the scenarios in which disposal of CRTs in landfills is prohibited and 50% of CRTs must be recycled (Cases 2S and 2L) using the Split EOL and Lumped EOL models are shown in Figures 5-3 and 5-4, respectively. Because of the elimination of the landfill disposal option, a large portion (over 47%) of the CRTs also is exported. Thus in a given year, similar quantities are expected for the recycling and export options.

Cases 3S and 3L: The results of the scenarios in which disposal of CRTs in landfills is banned and 50% of CRTs are sent overseas (Cases 3S and 3L) using the Split EOL and Lumped EOL models are shown in Figures 5-5 and 5-6, respectively. Similar to Cases 2S and 2L, because of the elimination of the landfill disposal option, a large portion (over 47%) of the CRTs also is exported. Thus in a given year, similar quantities are expected for the recycling and export options.

Cases 4S and 4L: The results of the scenarios in which disposal of CRTs is allowed in landfills, 25% of CRTs are recycled, and 25% of CRTs are sent overseas (Cases 4S and 4L) using the Split EOL and Lumped EOL models are shown in Figures 5-7 and 5-8, respectively. With the prescribed distribution that is recycled and exported, this results in over 47% of the CRTs sent to landfills, which represents the largest portion.

Cases 5S and 5L: The results of the scenarios in which disposal of CRTs allowed in landfills, 20% of CRTs are recycled, and 10% of CRTs are sent overseas (Cases 5S and 5L) using the Split EOL and Lumped EOL models are shown in Figures 5-9 and 5-10, respectively. With the prescribed distribution that is recycled and exported, this results in over 67% of the CRTs sent to landfills, which represents the largest portion. Cases 5S and 5L are similar to the base case (1S and 1L) (Tables 5-2 and 5-3).

Cases 6S and 6L: The results of the scenarios in which disposal of CRTs in landfills is prohibited and 75% of CRTs must be recycled (Cases 6S and 6L) using the Split EOL and Lumped EOL models are shown in Figures 5-11 and 5-12, respectively. With the majority of CRTs recycled, over 22% of CRTs are exported as a result.

Cases 7S and 7L: The results of the scenarios in which a small (5%) amount of CRTs allowed in landfills and 75% of CRTs must be recycled (Cases 7S and 7L) using the Split EOL and Lumped EOL models are shown in Figures 5-13 and 5-14, respectively. With the given distribution that is recycled and landfilled, over 17% of the CRTs are exported. Cases 7S and 7L are similar to Cases 6S and 6L.

For sensitivity analysis, Cases 6S-8S and 6L-7L (Tables 5-2 and 5-3) can be compared. Between Cases 6S, 7S, and 8S, Case 8S results in the sharpest decrease in TVs recycled starting in 2016 and in monitors recycled starting in 2008 compared to the other two cases. Note that Case 8S has similar portions of CRTs recycled and exported as Case 6S, but Case 8S was developed assuming specific portions sent to these options for each of the two EOL cycles (Table 5-1 and Figure 5-15). Comparing Cases 6L and 7L, the CRT quantities and trends for the disposal options are very similar, as expected. The only exception is for the quantities exported, in which the weight of both CRT monitors and TVs is significantly higher (up to 30-50% higher) Case 6L compared to Case 7L (Figures 5-12 and 5-14).

Cases 9S-11S: Additional cases using the Split EOL model represent other scenarios in which export and/or recycling are given other proportions during specific EOL cycles. For these cases, the proportion of CRTs sent to particular management options were prescribed for each of the two EOL cycles rather than cumulative EOL, as was done for Cases 2-7. In Case 9S, landfill disposal of CRTs was banned and 50% of CRTs were exported during the first and second EOL cycles, resulting in an overall proportion of 70% exported. The results of Case 9S, the majority of the CRTs is exported are shown in Figure 5-16. For Case 10S, CRTs are banned from landfills during the first EOL cycle but permitted during the second EOL cycle and 25% of CRTs are recycled and also exported during both EOL cycles. The results of

Case 10S, in which overall 23% of CRTs are sent to the landfill, 37% of CRTs are recycled, and 37% are exported), are shown in Figure 5-17. Case 11S is similar to Case 10S, except that 20% of CRTs are recycled and 10% are exported during both EOL cycles. The results of Case 11S, which CRTs are allowed in landfills (with an overall 47% proportion), 34% of CRTs are recycled, and 17% are exported, are shown in Figure 5-18. For Cases 10S and 11S, the peak quantity for the landfill option occurs at a slight time lag compared to the total quantities and other disposal options. This lag is due to the landfill ban during the first EOL cycle.

Results of the scenarios analyzed by the models provide comparative estimates on the required infrastructure necessary to handle the quantities of CRTs over time. For all cases, based on the historical and recent CRT sales data, the peak quantities of CRTs are expected in the next few years, between 2012-2016.

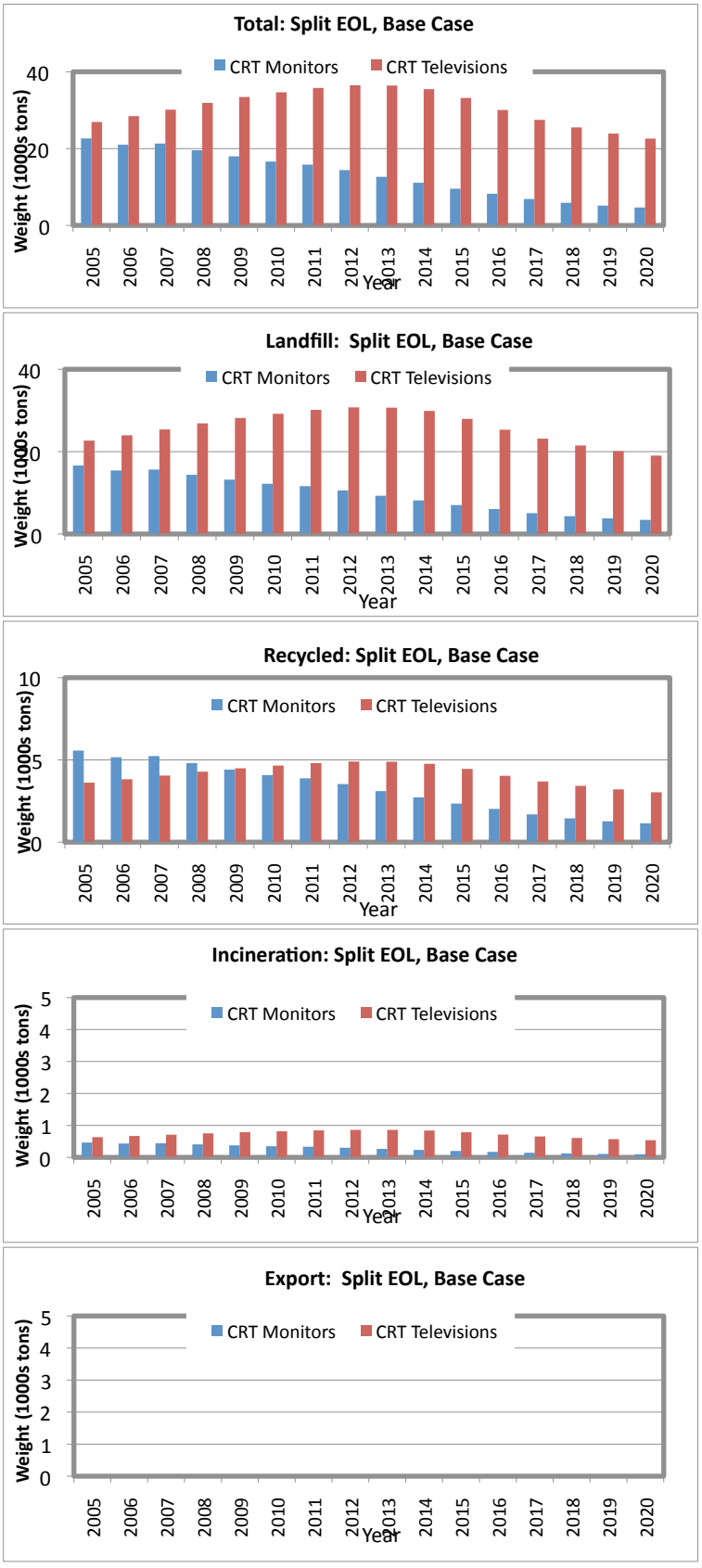


Figure 5-1. CRT quantities for Case 1S (base) from Split EOL model.

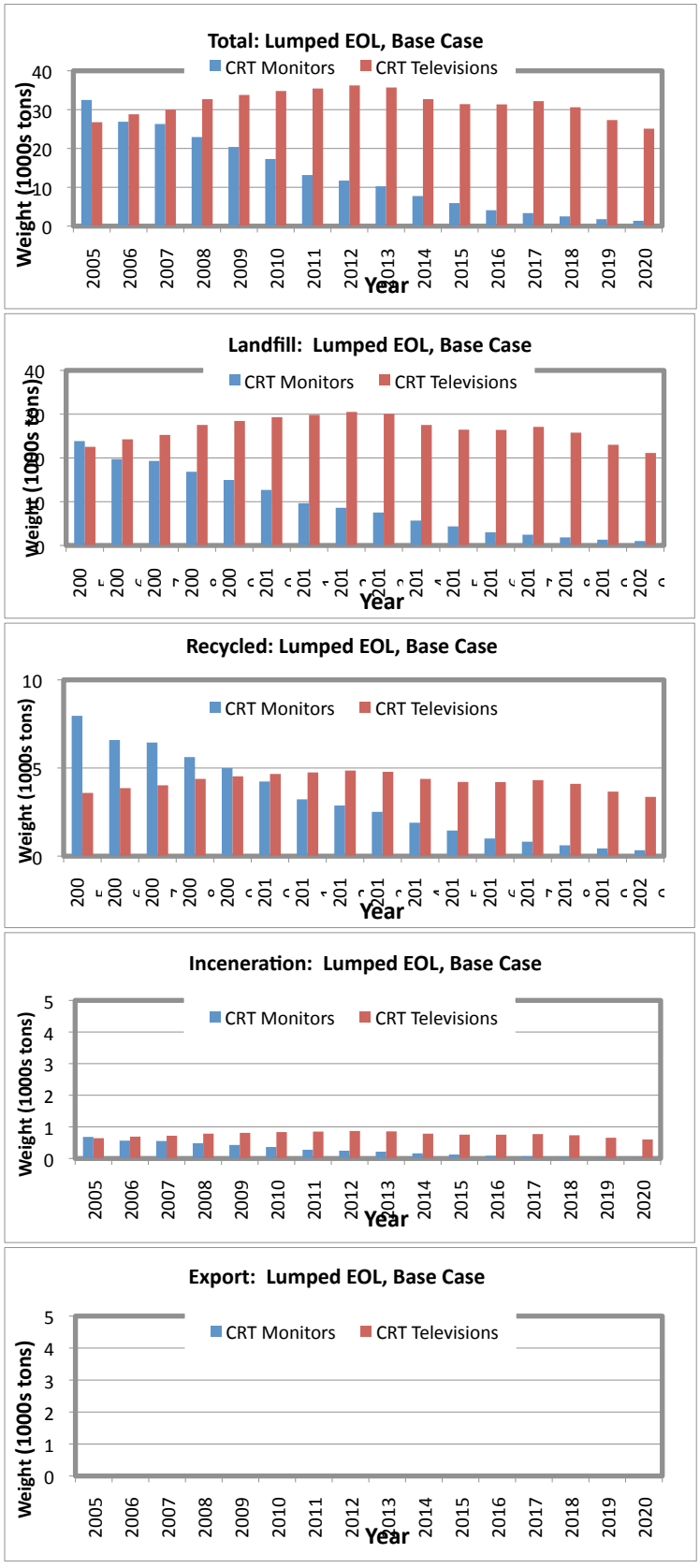


Figure 5-2. CRT quantities for Case 1L (base) from Lumped EOL model.

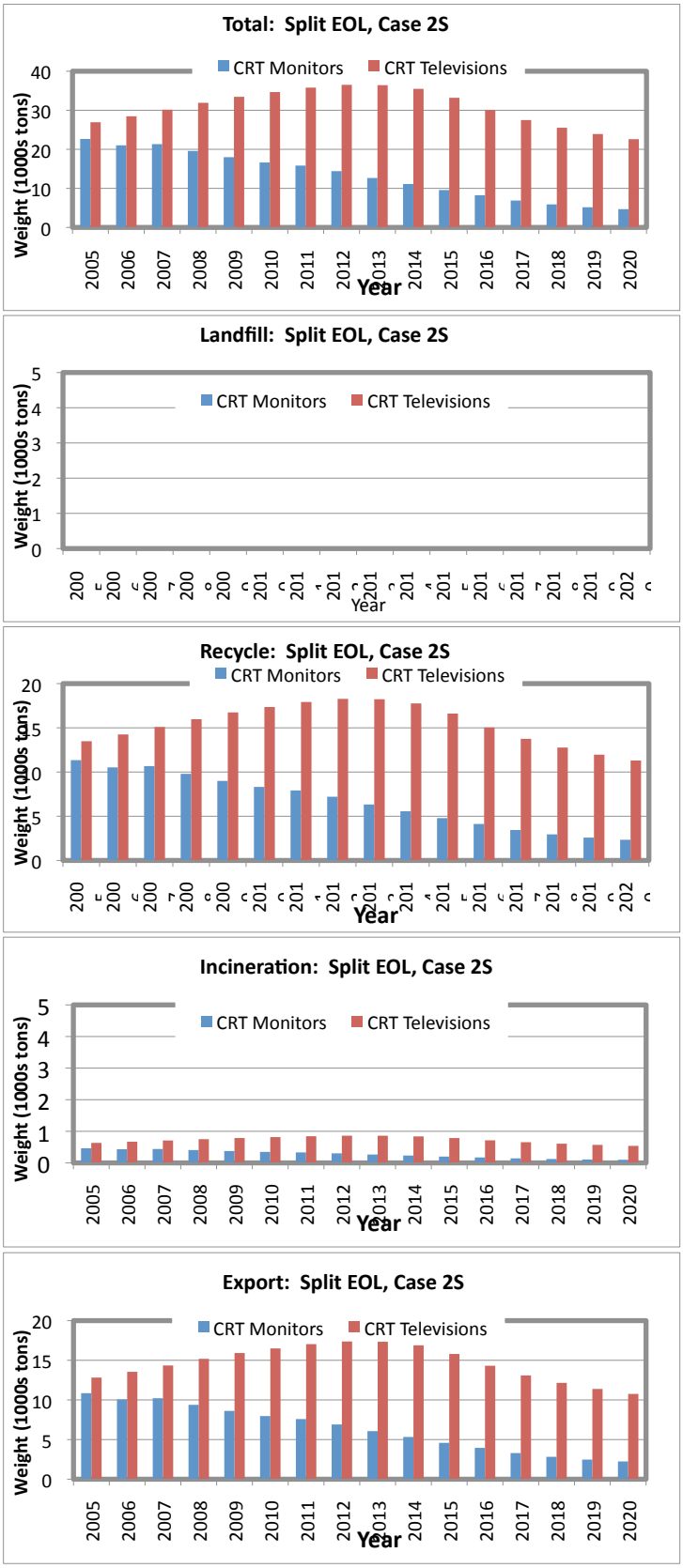


Figure 5-3. CRT quantities for Case 2S (0% landfill, 50% recycled) from Split EOL model.

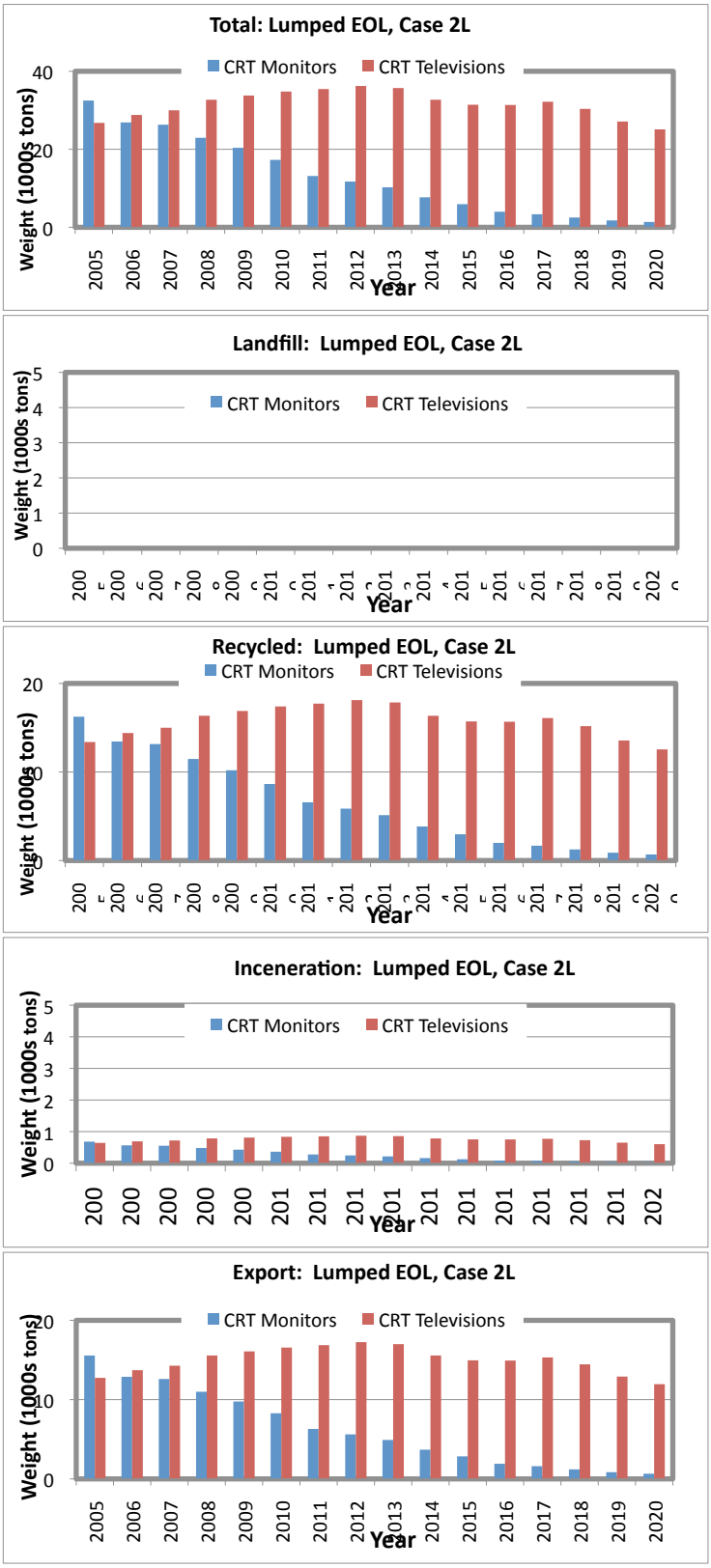


Figure 5-4. CRT quantities for Case 2L (0% landfill, 50% recycled) from Lumped EOL model.

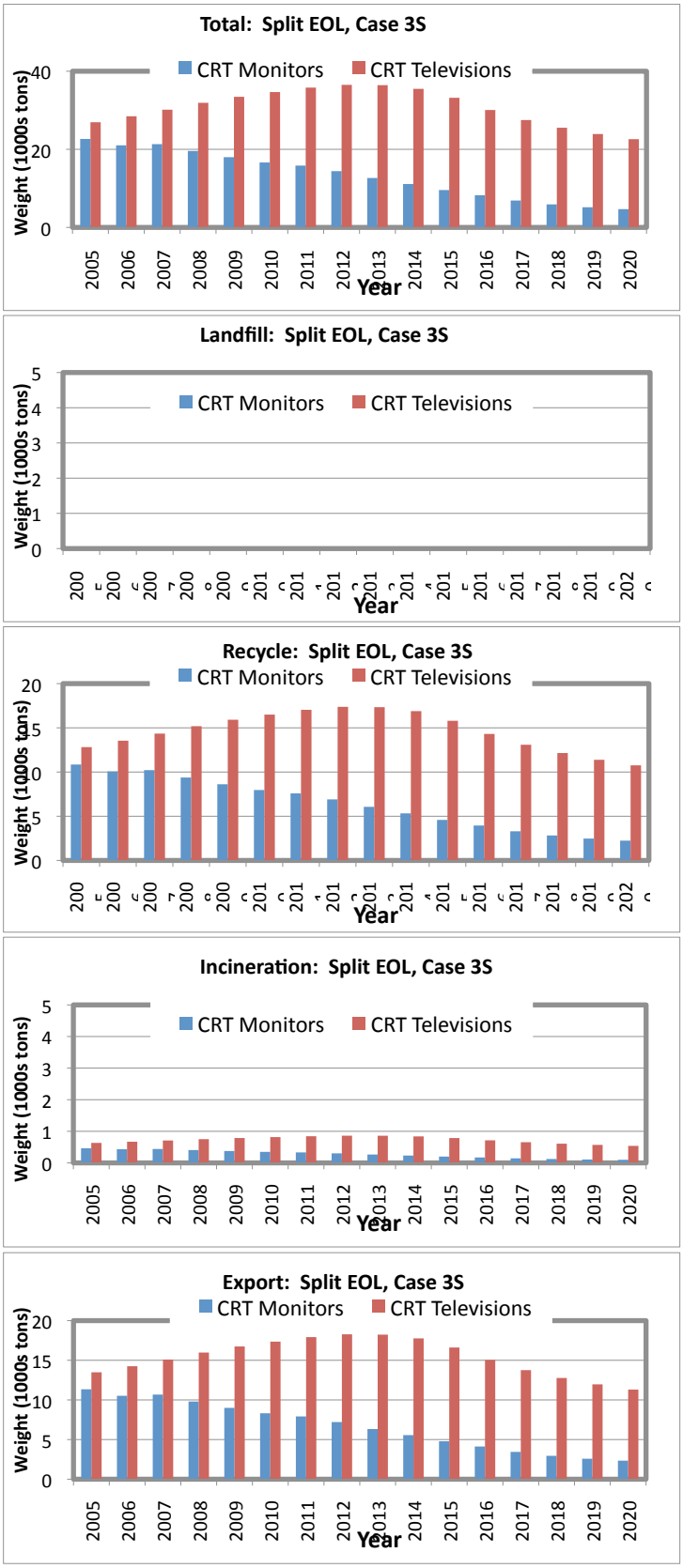


Figure 5-5. CRT quantities for Case 3S (0% landfill, 50% exported) from Split EOL model.

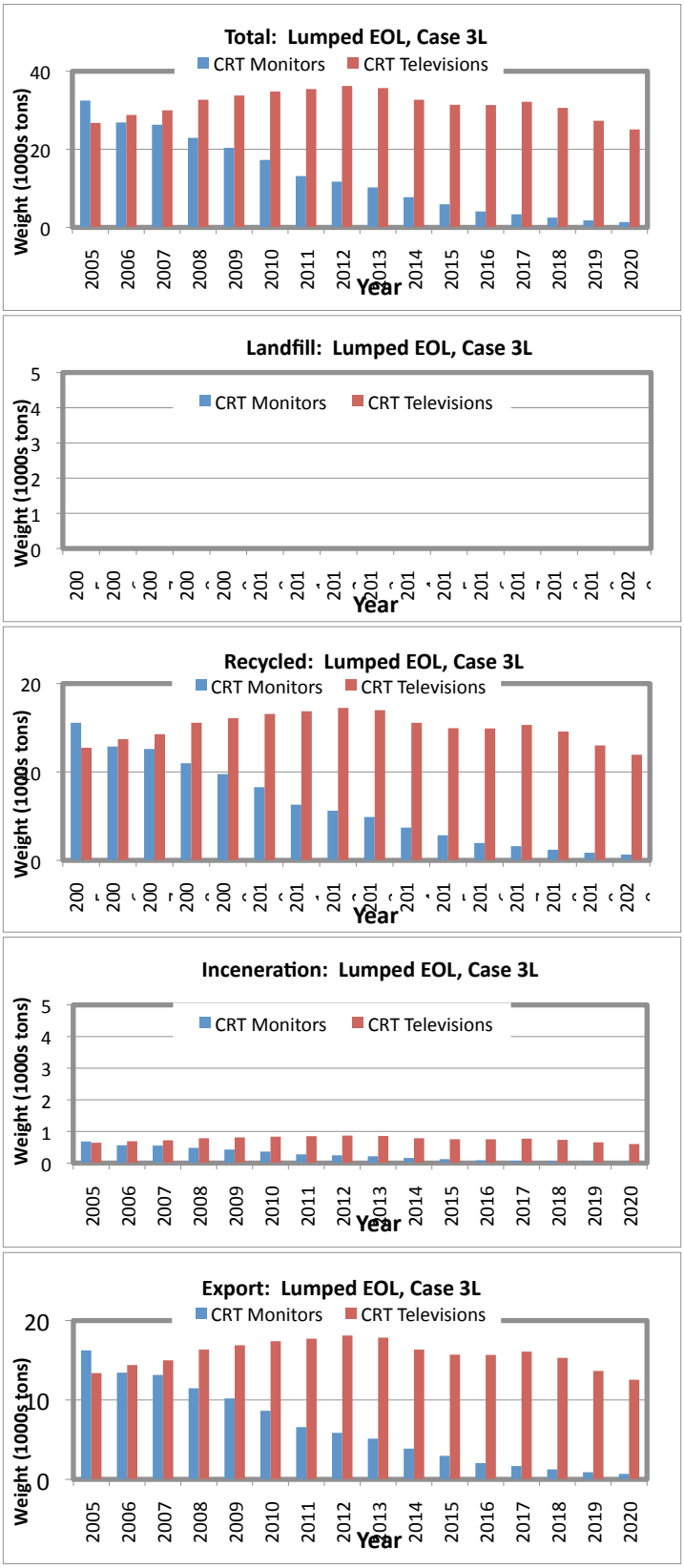


Figure 5-6. CRT quantities for Case 3L (0% landfill, 50% exported) from Lumped EOL model.

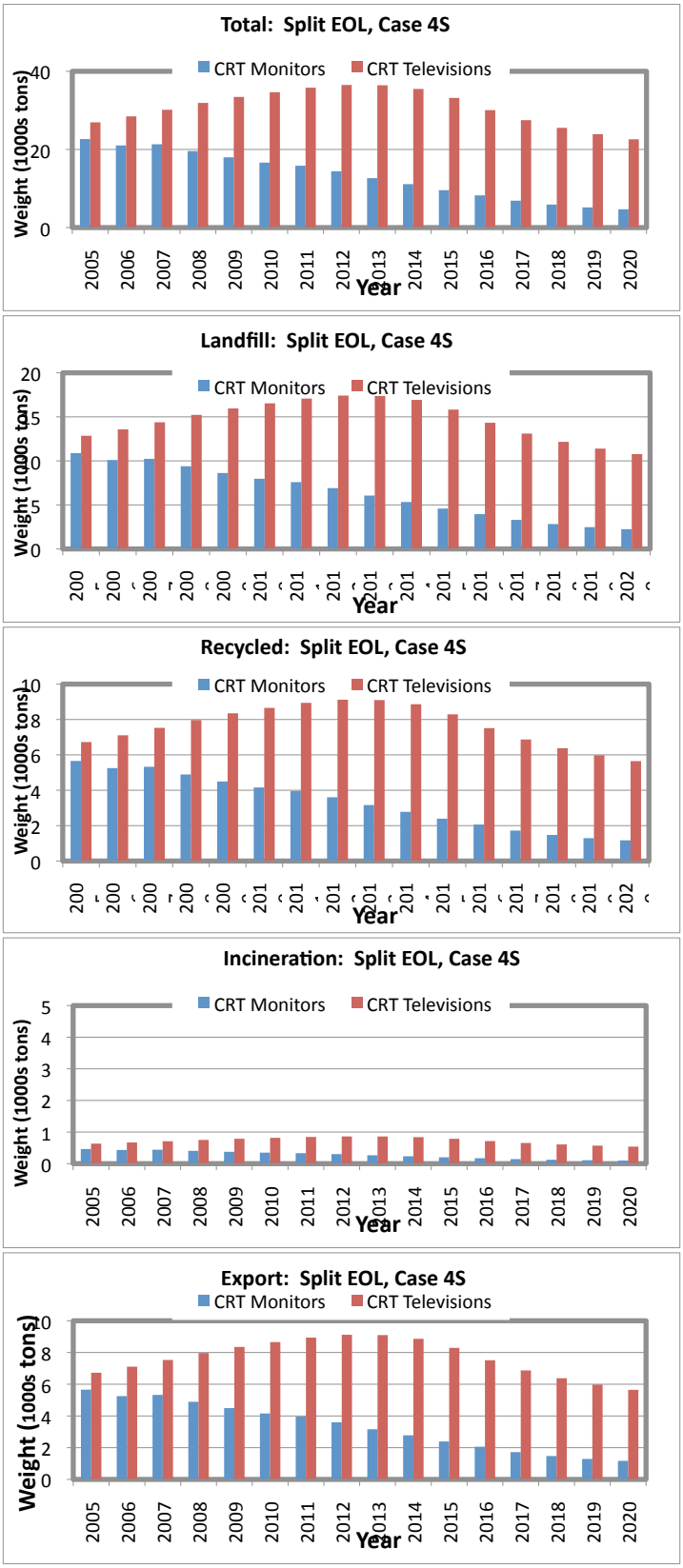


Figure 5-7. CRT quantities for Case 4S (0% landfill, 25% recycled, 25% exported) from Split EOL model.

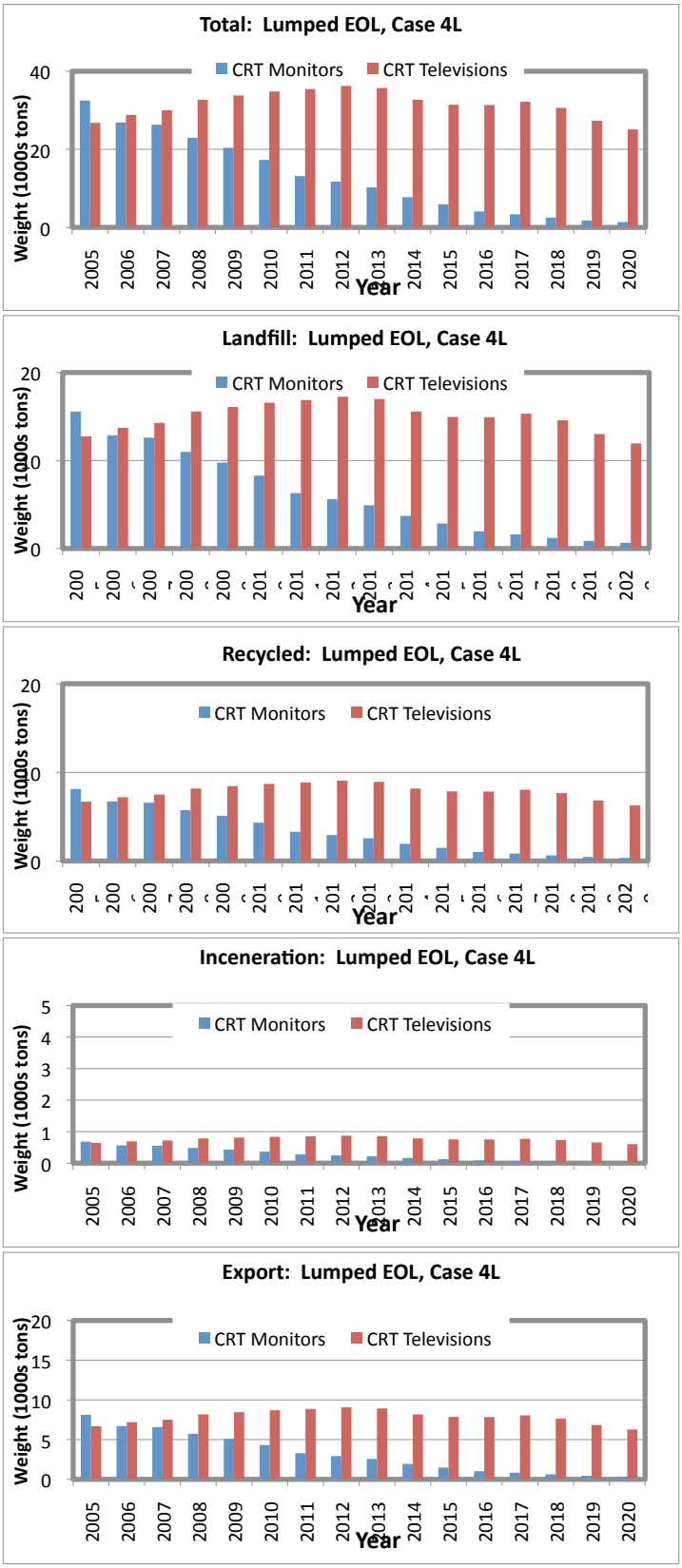


Figure 5-8. CRT quantities for Case 4L (0% landfill, 25% recycled, 25% exported) from Lumped EOL model.

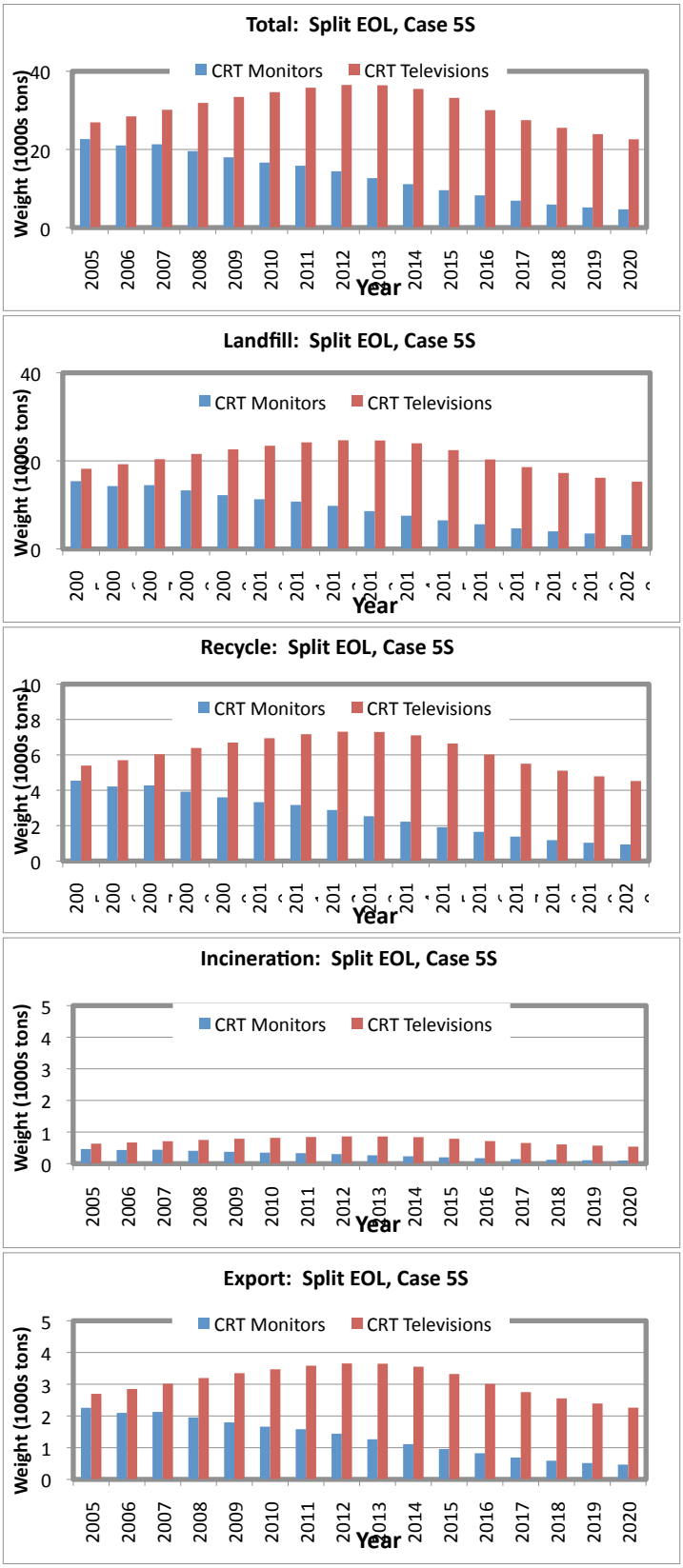


Figure 5-9. CRT quantities for Case 5S (20% recycled, 10% exported) from Split EOL model.

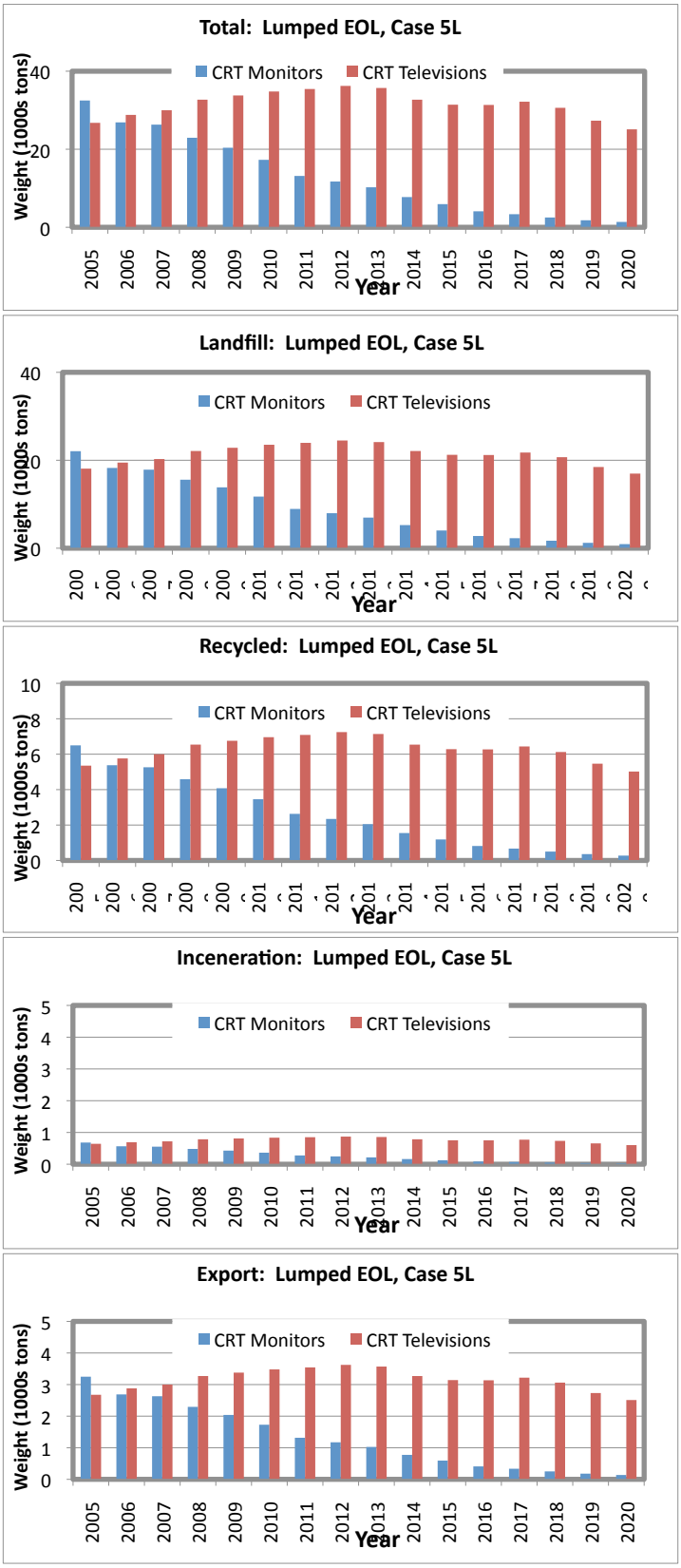


Figure 5-10. CRT quantities for Case 5L (20% recycled, 10% exported) from Lumped EOL model.

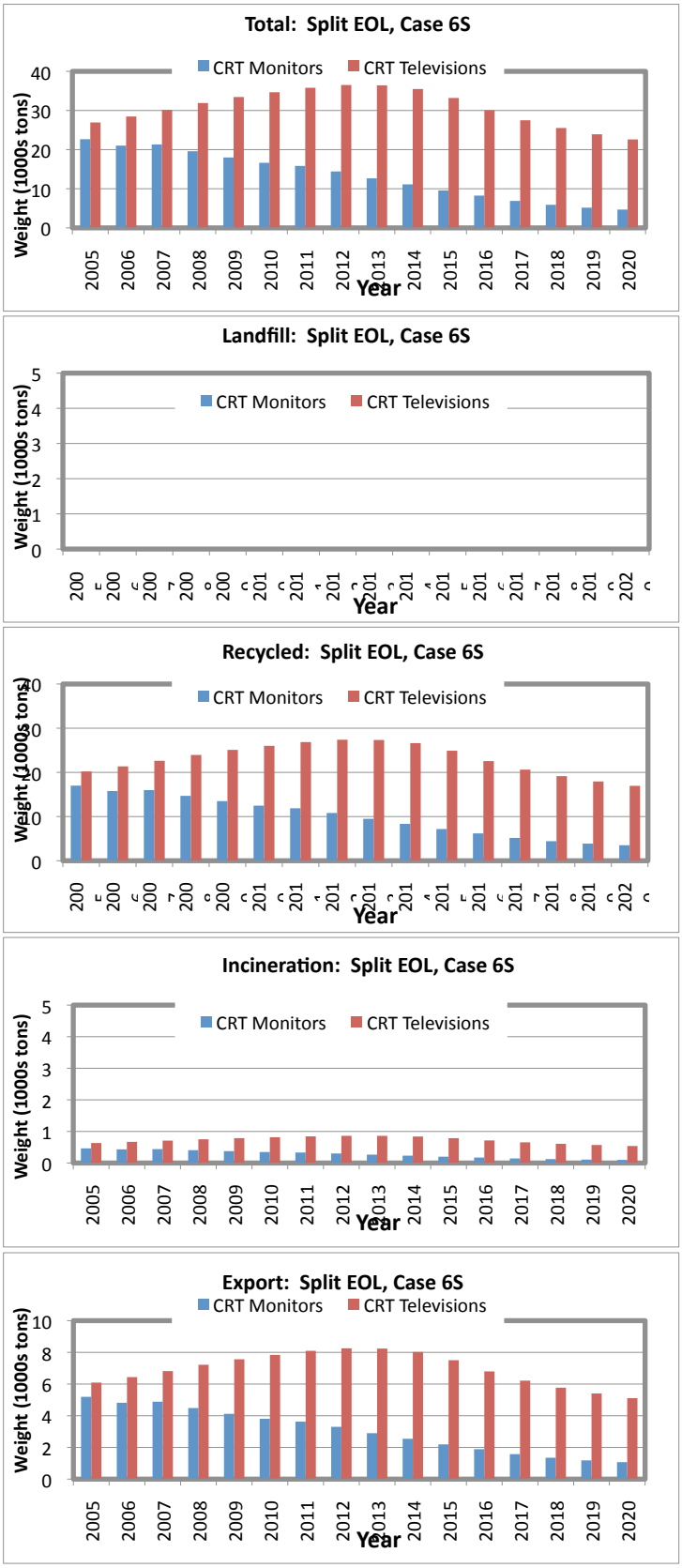


Figure 5-11. CRT quantities for Case 6S (0% landfill, 75% recycled) from Split EOL model.

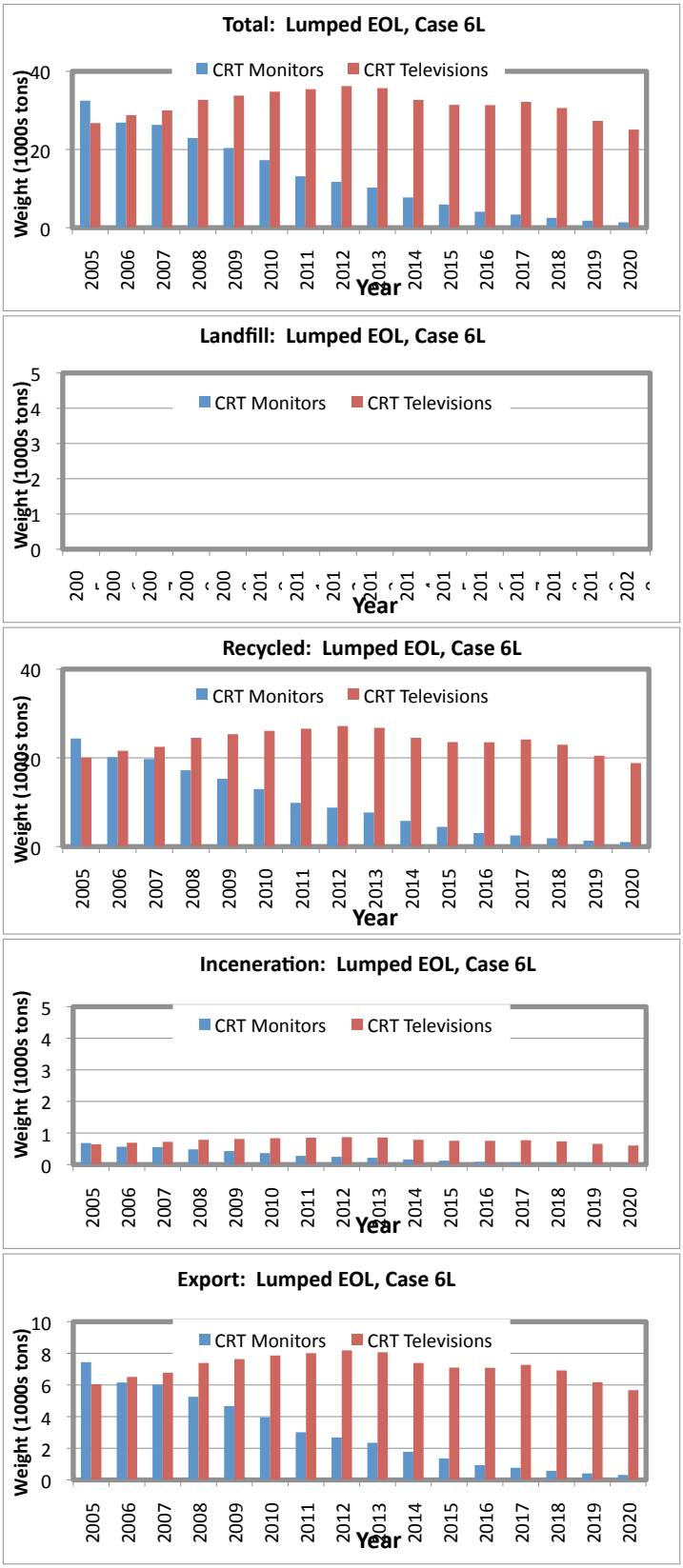


Figure 5-12. CRT quantities for Case 6L (0% landfill, 75% recycled) from Lumped EOL model.

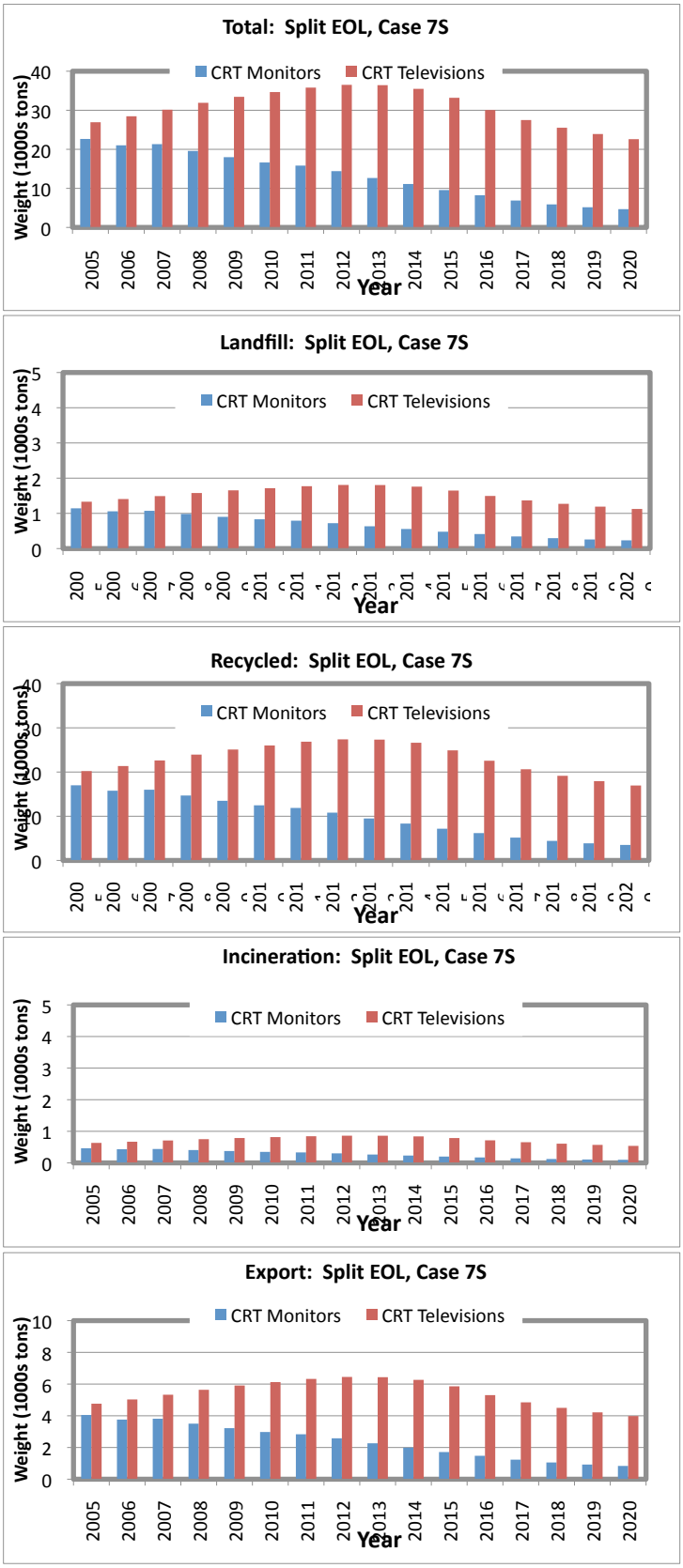


Figure 5-13. CRT quantities for Case 7S (5% landfill, 75% recycled) from Split EOL model.

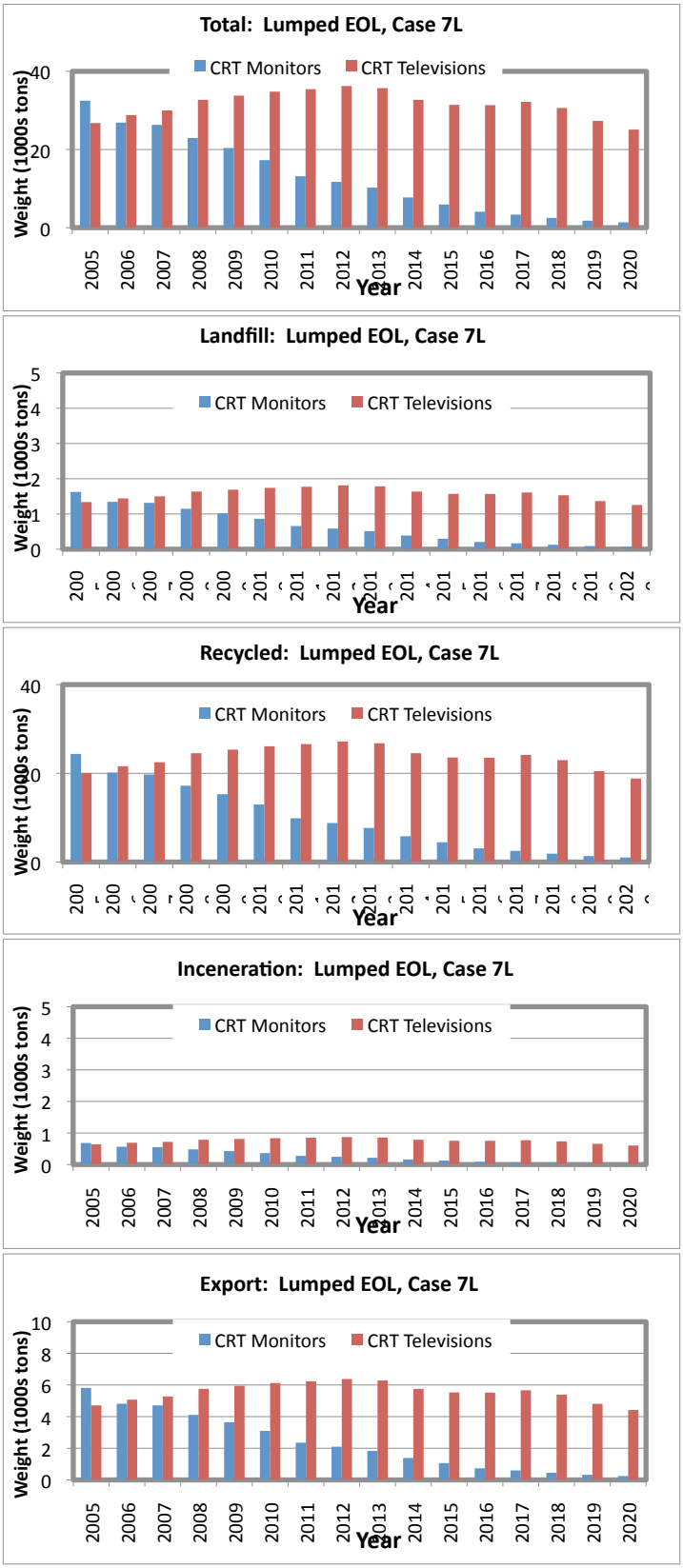


Figure 5-14. CRT quantities for Case 7L (0% landfill, 75% recycled) from Lumped EOL model.

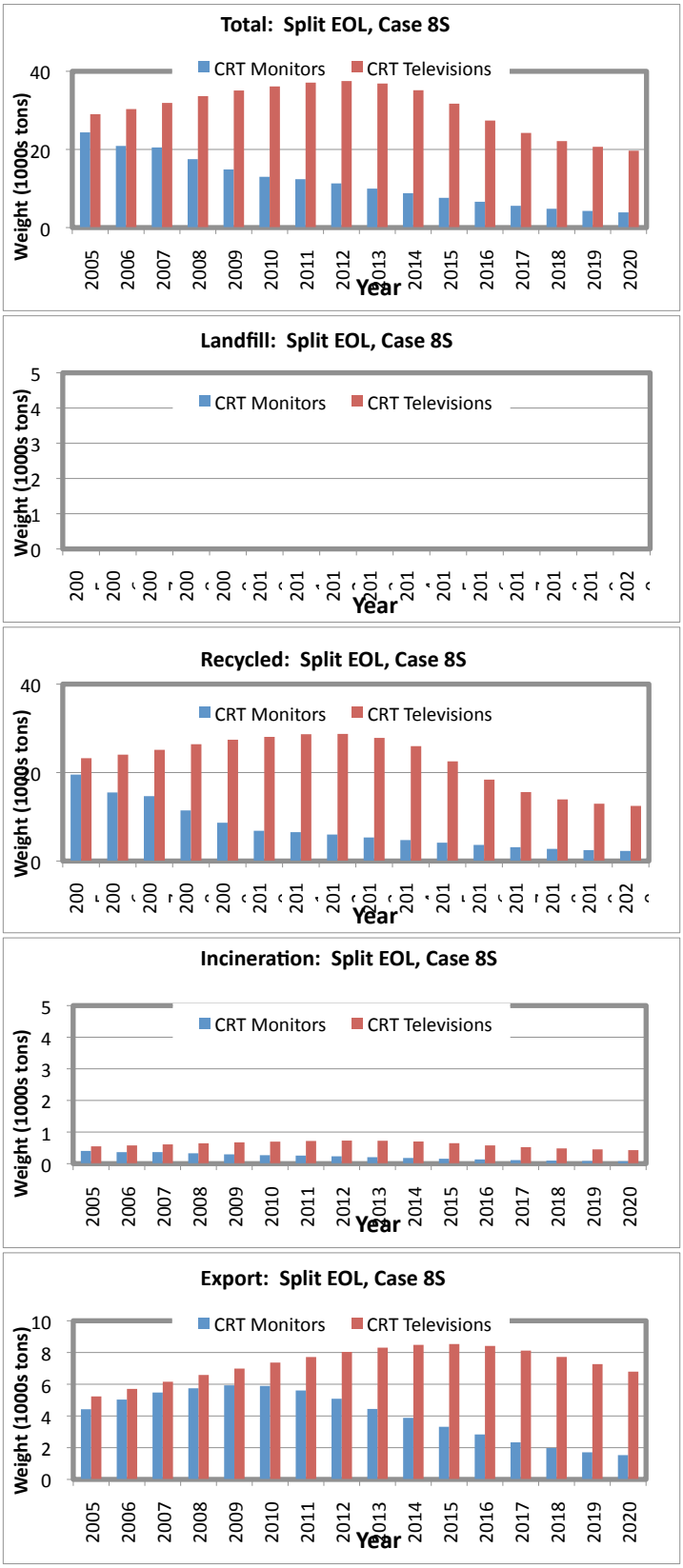


Figure 5-15. CRT quantities for Case 8S (0% landfill, 74% recycled) from Split EOL model.

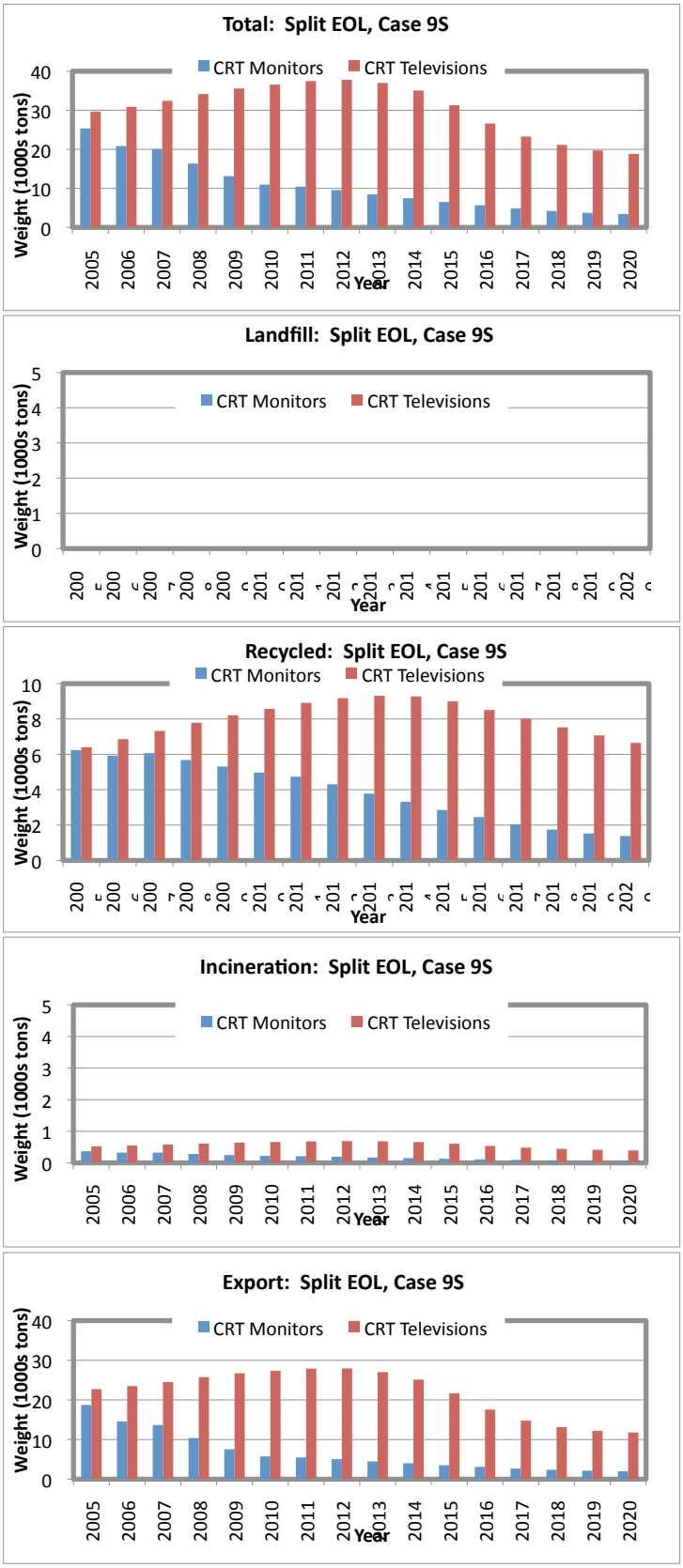


Figure 5-16. CRT quantities for Case 9S (0% landfill, 70% exported) from Split EOL model.

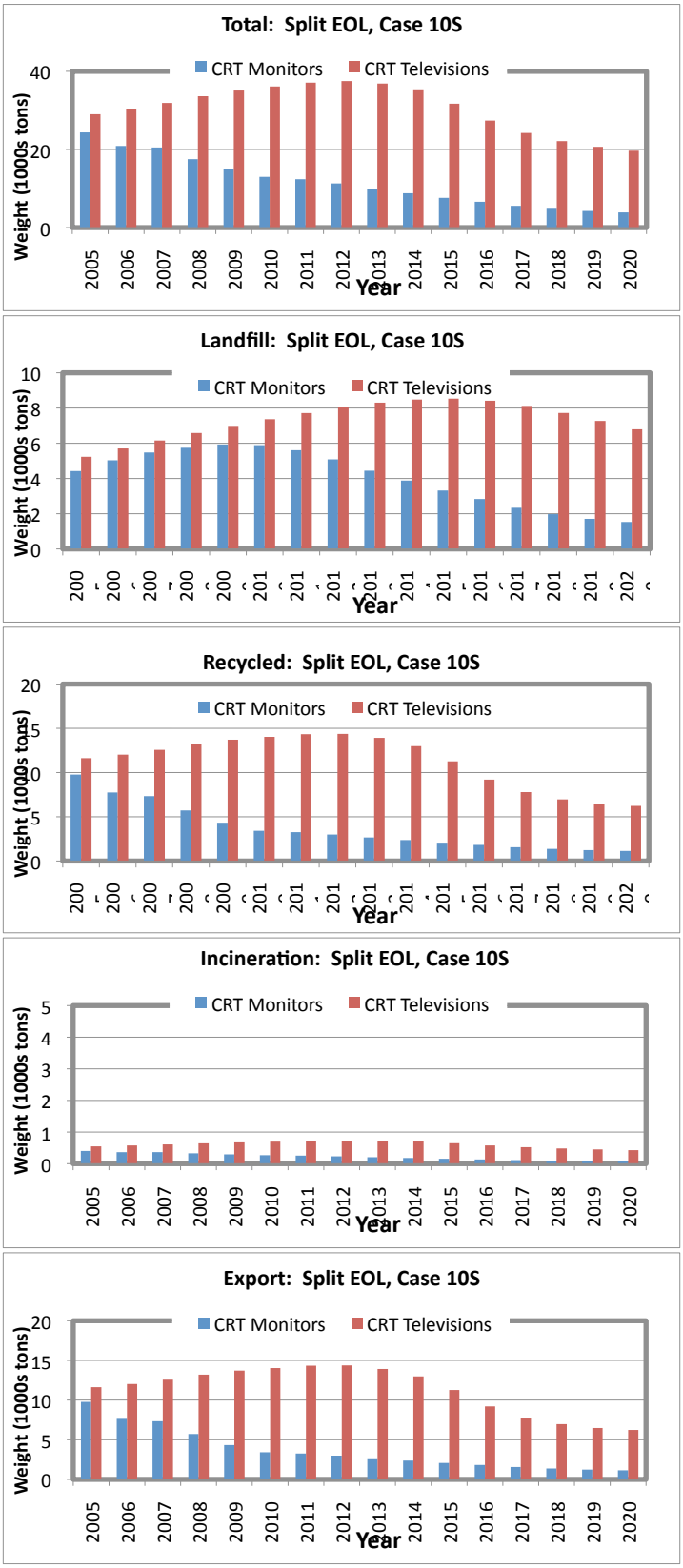


Figure 5-17. CRT quantities for Case 10S (23% landfill, 37% recycled, 37% and exported) from Split EOL model.

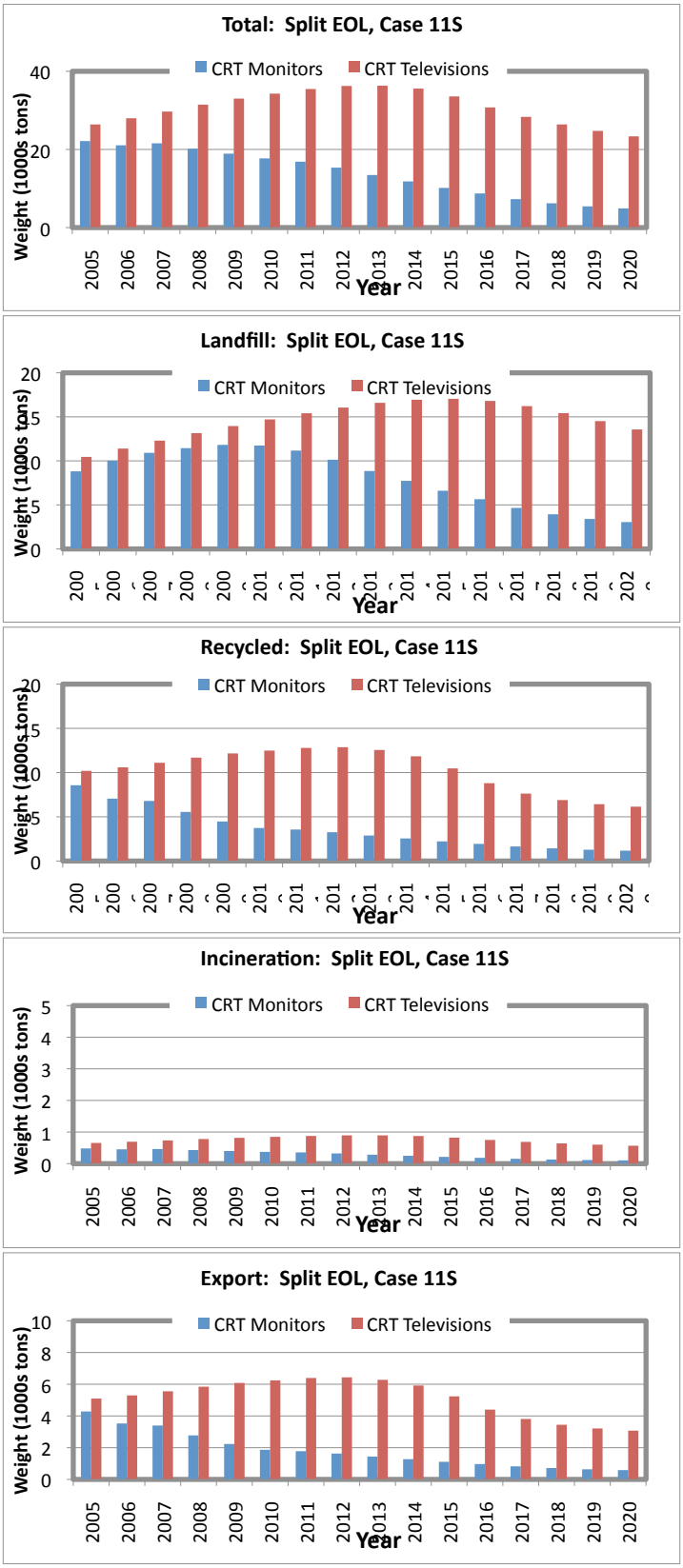


Figure 5-18. CRT quantities for Case 11S (47% landfill, 34% recycled, 17% and exported) from Split EOL model.

6. Conclusions

6.1 Overall Conclusions

The goal of this research was to answer questions about trends in volume of discarded CRTs, current CRT waste management practices and trends, and capacity for handling increases in CRT disposal in Florida, as well as provide a tool for the analysis of potential changes in CRT disposal management practices and policies.

Information about current CRT disposal volumes and management practices in Florida was collected from municipalities and electronics recycling facilities. Surveys were sent to county household hazardous waste managers, electronics recyclers, and donation centers during spring 2009 to collect information about quantities of CRTs received, recent trends in quantities, disposal and recycling practices and limitations, and fees and costs. A follow-up survey was conducted during spring 2010, after the implementation of the switch to digital television signal transmission. Between the two round of surveys, a total of 14 counties, 6 electronics recyclers, and 1 regional donation center responded to the surveys, with most counties and some recyclers responding to both surveys. As expected the quantities of CRTs collected were dependent on the size of the county or recycling facility. In general, counties received more TVs compared to computer monitors while recyclers received more monitors compared to TVs. During 2008 and 2009, counties saw little to up to 65% increase in the quantities of CRTs received, while recyclers saw no significant to a moderate increase (although one recycler saw a decrease in CRT quantities in 2009). These trends are attributed to decreases in the prices of flat screen TVs and monitors, seasonal events, and the digital television signal switch. Both municipalities and electronics recyclers did not anticipate any limitations to their capacity to receive and process CRTs.

A materials flow model that tracks the life cycle of a CRT from sales to use to disposal was developed. Two versions of a user-friendly spreadsheet model were developed based on US EPA (2007 and 2008) to estimate future volumes of discarded CRTs: the Split EOL model and Lumped EOL model. The two models differ in the way CRTs are tracked, either using two end-of-life (EOL) cycles (Split EOL) or a single EOL cycle (Lumped EOL), and the EOL duration data used to account for the EOL cycles. In both models, disposal options included landfill, recycle, incinerate, and export; the Split EOL model also allowed for storage/reuse during the first EOL cycle. CRT flow for both TVs and monitors are tracked for a 35-year duration, from 1985-2020. The models include default sales, EOL duration, and disposal option proportion data from published information, from US EPA (2007, 2008), and have the flexibility for the user to change any or all of the data to suit individual needs. The models were verified by applying them to a case study for Broward County, Florida, and comparing the results with the survey data.

Finally, the CRT flow models were applied to analyze multiple CRT disposal management options for Florida. A total of eleven scenarios using the Split EOL model and seven scenarios using the Lumped EOL model were analyzed. The different cases varied in the proportion of CRTs allowed in landfills, were required to be recycled, or were exported. Trends in the total quantities of CRT monitors and TVs that are expected in any given year,

based on the assumed input data on CRT sales and EOL durations, as well as quantities that are expected in landfills or to be recycled, incinerated, or exported were determined through the models. Results of the scenarios analyzed by the models provide comparative estimates on the required infrastructure necessary to handle the quantities of CRTs over time. For all cases, based on the historical and recent CRT sales data, the peak quantities of CRTs are expected in the next few years, between 2012-2016.

6.2 Benefits to End Users

The results of this project have multiple direct benefits to end users. Currently, limited information about the CRT waste stream in Florida is available, and projections are necessary in order to align management practices, infrastructure options, and potential policies with the demands of future CRT discards. Synthesis of data on the current status of CRT processing and disposal practices in Florida provides municipalities, reuse, demanufacturing, and recycling facility managers, and regulators the latest data and trends on CRT quantities and disposal practices. Estimates on future CRT trends, based on the materials flow models developed, provide data for managers and policy makers on the local and state level make decisions about expanding infrastructure to handle CRT waste management. The spreadsheet-based Split EOL and Lumped EOL models developed in this research allow end users to analyze policy and management practices not specifically addressed in this research and/or use local- or region-specific input data. Issues such as policy changes were specifically analyzed with this tool to assist the end user.

6.3 Deliverables

This project resulted in the production of multiple deliverables throughout the project period. These include:

- Summary of the two surveys on CRT recycling in Florida: This is a major product of this research.
- Spreadsheet-based CRT disposal management modeling tools – Split EOL and Lumped EOL models: These are major products of this research.
- A project description (abstract) for the general public: This was submitted to the Center at the beginning of the project period.
- A project web site: This was established and regularly maintained to make project deliverables and results available to the public. The project web site was established at http://www.eng.fsu.edu/~abchan/CRTanalysis.html. The web site includes the project abstract, list of project participants, and Technical Awareness Group (TAG) members, TAG meeting minutes, and project reports.
- Two technical awareness group (TAG) meetings were held (during December 2008 and February 2010) to provide guidance and feedback on all tasks.
- Quarterly Progress Reports and a Draft Final Technical Report: These reports provide summaries of the results of the study.
- Project results were presented at a SWANA conference in February 2010. We also plan to prepare and submit a technical paper to peer-reviewed journals for publication.

Information Dissemination

Information obtained and resulting form this project was disseminated in multiple ways. A project web site was established and maintained to make available to the information widely available. The project web site includes a general description of the project, a listing of the project team and TAG, copies of quarterly and final reports, and links to relevant references. The spreadsheet-based CRT management tool also will be made available on the project web site.

Presentations and papers at conferences were used to disseminate project results to the waste management sector and regulators within and outside of Florida. In particular, results of this project was presented at a SWANA conference:

> Chan Hilton, A.B., D. Mukherjee, and L. Cui. Analysis of Discarded CRTs in Florida: Volume Projections and Disposal Management Options. SWANA Thinking Outside of the Blue Box Conference, February 8-9, 2010, Charlotte, NC. http://thinkingoutsidethebluebox.org/Conference/tabid/335/Default.aspx

Plans are underway to prepare and submit a manuscript for publication in a peer-reviewed technical journal, such as *Waste Management* or *Journal of Environmental Management*.

The project team will continue to work with the TAG to identify additional end users (regulators, municipalities, CRT reuse, demanufacturing, and recycling facilities, and others) that will be interested in the results of this project.

6.4 Technical Advisory Group (TAG)

A Technical Awareness Group (TAG) was formed at the start of the project. TAG members consist of experts, regulators, and practitioners from state and local government, academia, and industry. The purpose of the TAG was to provide feedback to the project team and to provide opportunities for dialog on CRT and e-scrap disposal management between the project team TAG members, and the community. TAG members included:

Jack Price Florida Department of Environmental Protection Division of Waste Management Bureau of Solid and Hazardous Waste 2600 Blair Stone Road Tallahassee, Florida 32399-2400 Email: John.L.Price@dep.state.fl.us	Raoul Clarke Florida Department of Environmental Protection Division of Waste Management Bureau of Solid and Hazardous Waste 2600 Blair Stone Road Tallahassee, FL 32399-2400 Email: Raoul.Clarke@dep.state.fl.us

Norm Thomas Director Leon County Solid Waste Management Division 550 Apalachee Parkway Tallahassee, FL 32311 Email: thomasno@leoncountyfl.gov	Cyndy Brantley Recycling Coordinator Leon County Solid Waste Management Division 550 Apalachee Parkway Tallahassee, FL 32311 Email: brantleyc@leoncountyfl.gov
Randy Jones Executive Vice President Goodwill Industries Big Bend, Inc. 2800 W. Tennessee Street Tallahassee, FL 32304 Email: rjjones@goodwillbigbend.com	Ben Bonnell Assistant Manager Goodwill Industries Big Bend, Inc. 2800 W. Tennessee Street Tallahassee, FL 32304 Email: cpuam@goodwillbigbend.com

Project Team

- Amy B. Chan Hilton, PhD, PE – Principal Investigator
- Gang Chen, PhD, PE – Co-Principal Investigator
- Libo Cui – PhD student
- Dinesha Kodituwakku – Research assistant
- Debraj Mukherjee – PhD student
- Dan Mathis – Undergraduate student

References

Day, JC, Janus, A and Davis, J. *Computer and Internet Use in the United States 2003*, October 2005. http://www.census.gov/prod/2005pubs/p23-208.pdf

Dwivedy, M. and R.K. Mittal. Estimation of future outflows of e-waste in India, *Waste Management*, 30, 483-491, 2010. doi:10.1016/j.wasman.2009.09.024

Electronics TakeBack Coalition. State Legislation, 2010a. Accessed June 2010. http://www.computertakeback.com/legislation/state_legislation.htm

Electronics TakeBack Coalition. Scope of Products in E-Waste Laws, June 2010b. http://www.computertakeback.com/legislation/Scope_of_Product_in_Ewaste_Laws.pdf

European Environmental Agency (EEA), *Waste from Electrical and Electronic Equipment-quantities, Dangerous Substances and Treatment Methods*, European Topic Center on Waste, 2003.

Florida Department of Environmental Protection (FDEP), Florida Used Electronic Equipment Donations Contact, 2007. http://www.dep.state.fl.us/waste/quick_topics/publications/shw/electronics/FLDonationList110507.pdf

Florida Department of Environmental Protection (FDEP), Digital Conversion Frequently Asked Questions (FAQ), 2008. http://www.dep.state.fl.us/waste/quick_topics/publications/shw/electronics/TV/DEPDigitalConversionFAQ031908beta.pdf

Florida Department of Environmental Protection (FDEP), Florida Contacts for Television, Computer and Electronics Demanufacturing and Recycling, 2010. http://www.dep.state.fl.us/waste/quick_topics/publications/shw/electronics/Recylist_17May10.pdf

Florida Department of Environmental Protection (FDEP), Focus on Televisions and Computer Monitors: Lead (Pb), 2008c. http://www.dep.state.fl.us/waste/categories/electronics/pages/lead.htm

Gable, C and Shireman, B. Computer and electronic product stewardship: are we ready for the challenge? In: Axion Books, Environmental Quality Management, 35-45, 2001.

Gutiérrez, E., B. Adenso-Díaz, S. Lozano, and P. González-Torre. A competing risks approach for time estimation of household WEEE disposal, *Waste Management*, 30, 1643-1652, 2010. doi:10.1016/j.wasman.2010.02.032

Kang, H-Y and Schoenung, JM. Electronic waste recycling: A review of U.S. infrastructure and technology option. *Resources, Conservation & Recycling*, 45, 368-400, 2005.

Kang, H-Y and Schoenung, JM. Estimation of future outflows and infrastructure needed to recycle personal computer systems in California. *Journal of Hazardous Materials*, B137, 1165-1174, 2006.

Kessler Consulting, Inc. State of Electronics in Florida: 2003 Donation Center and Thrift Store Electronics Survey, Final Report, 2003. http://www.dep.state.fl.us/waste/quick_topics/publications/shw/electronics/FloridaElectronicsThriftCenterSurvey2003ReportCorrected.pdf

Kessler Consulting, Inc., State of Electronics in Florida Households: Residential Household Electronics Survey, Final Report, 2004. http://www.dep.state.fl.us/waste/quick_topics/publications/shw/electronics/FloridaElectronicsResidentialSurvey2003ReportCorrected.pdf

Kiatkittipong, W, Wongsuchoto, P, Meevasana, K, and Pavasant, P. When to buy new electrical/electronic products? *Journal of Cleaner Production*, 16, 1339-1345, 2008. doi:10.1016/j.jclepro.2007.06.019

Kiuchi, T, Gable, C, Cassel, S., Shireman, B., Computers, E-waste and Product Stewardship: Is California Ready for the Challenge? Report for the US Environmental Protection Agency Region IX. Global Futures Foundation The Future 500, May 2001.

Kollikkathara, N., H. Feng, and E. Stern. A purview of waste management evolution: Special emphasis on USA, *Waste Management* 29, 974-985, 2009. doi:10.1016/j.wasman.2008.06.032

Lee, C-H, et al. An overview of recycling and treatment of scrap computers, *J. Hazardous Materials*, 114, 93-100, 2004.

Lee, J-c, Song, HT, and Yoo, J-M. Present status of the recycling of waste electrical and electronic equipment in Korea. *Resources, Conservation & Recycling*, 50, 380-397, 2007.

Lintona, J.D., J.S, Yeomansb, and R. Yoogalingam. Recovery and reclamation of durable goods: a study of television CRTs. *Resources, Conservation and Recycling*, 43, 337-352, 2005. doi:10.1016/j.resconrec.2004.06.008

Lundy, C. An environmental systems analysis of cathode ray tube waste management. MS Thesis, Florida State University, Tallahassee, FL, 2006.

Macauley, M, Palmer, K, and Shih, J-S. Dealing with electronic waste: modeling the costs and environmental benefits of computer monitor disposal. *Journal of Environmental Management*, 68, 13-22, 2003.

Méar, F. et al. The characterization of waste cathode-ray tube glass. *Waste Management*, 26, 1468-1476, 2006.

National Recycling Coalition, *Florida's Strategy for the Management of End of Life Cathode Ray Tubes (CRTs), Computers and Other Electronic Equipment*, Discussion Paper, September 1999, http://www.nrc-recycle.org/resources/electronics/docs/florida.pdf

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

Ni, H.-G. and E.Y. Zeng. Law Enforcement and Global Collaboration are the Keys to Containing E-Waste Tsunami in China, *Environmental Science & Technology,* 43, 3991-3994, 2009. doi:10.1021/es802725m

Nixon, H and Saphores, J-D. Financing electronic waste recycling Californian households' willingness to pay advanced recycling fees. *Journal of Environmental Management*, 84, 547-559, 2007.

Price, JL. Reclaiming End-of-Life Cathode Ray Tubes (CRTs) and Electronics: A Florida Update, 1999 Hazardous Waste Management Conference, Tucson, AZ, 1999. http://www.dep.state.fl.us/waste/quick_topics/publications/shw/electronics/crt_az99.pdf

Product Stewardship Institute, Update on Electronics Product Management, 2003. http://www.dep.state.fl.us/waste/quick_topics/publications/shw/electronics/PSIElectronicsUpdateSpring2003.pdf

Puckett and Smith. Exporting harm: the high-tech trashing of Asia. The Basel Action Network, Silicon Valley Toxics Coalition, Seattle, 2002.

Saphores, J.-D.M., et al., How much e-waste is there in US basements and attics? Results from a national survey, *Journal of Environmental Management*, 2009, doi:10.1016/j.jenvman.2009.05.008

Sinha-Khetriwala, D, Kraeuchib, P, Schwaninger, M. A comparison of electronic waste recycling in Switzerland and in India. *Environmental Impact Assessment Review*, 25, 492-504, 2005.

Steubing, B., H. Böni, M. Schluep, U. Silva, and C. Ludwig. Assessing computer waste generation in Chile using material flow analysis, *Waste Management*, 30, 473-482, 2010. doi:10.1016/j.wasman.2009.09.007s

Townsend, TG et al. Characterization of lead leachability from cathode ray tubes using the toxicity characteristic leaching procedure. Report #99-5, Florida Center for Solid and Hazardous Waste Management, Gainesville, FL, 1999.

US Census Bureau, Accessed December 2005. http://www.census.gov/Press-Release/www/releases/archives/facts_for_features/001702.html

US Census Bureau, Table 1: Annual Estimates of the Resident Population for Counties of Florida: April 1, 2000 to July 1, 2008 (CO-EST2008-01-12), 2009. http://quickfacts.census.gov/qfd/states/12000lk.html

US Environmental Protection Agency, 2010. http://www.epa.gov/epaoswer/hazwaste/recycle/ecycling/faq.htm

US Environmental Protection Agency, Electronics Waste Management in the United States, Approach 1, Final, Office of Solid Waste, EPA530-R-08-009, July 2008. http://www.epa.gov/epawaste/conserve/materials/ecycling/manage.htm

US Environmental Protection Agency, Management of Electronic Wastes in the United States, Approach Two, Draft Final Report, Office of Solid Waste, EPA530-R-07-004a, April 2007. http://www.epa.gov/epawaste/conserve/materials/ecycling/manage.htm

US Government Accountability Office (GAO), Electronic Waste: Observation on the Role of the Federal Government in Encouraging Recycling and Reuse: Testimony Before the Subcommittee on Superfund and Waste Management, Committee on Environment and Public Works, U.S. Senate (July 26, 2005), 2005. http://www.gao.gov/new.items/d05937t.pdf

Widmer, R et al. Global perspectives on e-waste. *Environmental Impact Assessment Review*, 25, 436-458, 2005.

Williams, J.A.S. A review of electronics demanufacturing processes. *Resources, Conservation and Recycling*, 47, 195–208, 2006. doi:10.1016/j.resconrec.2005.11.003

Appendix A – Surveys on CRT Recycling (Spring 2009)

The following surveys were sent electronically to county household hazardous waste managers, recycling center managers, and donation centers during the February-March 2009.

2009 Survey to County Household Hazardous Waste Managers on CRT Recycling

Note: If you do not have actual data or percentages, please provide your best estimates and note this in your responses.

1) Method of CRT collection:
   a) How are CRTs collected: Curbside pick-up? Drop-off centers? Collection events? Other (please explain)?
   b) How many (or weight or percentage) from each collection source? What is the frequency of each collection source?
   c) Do you collect from private citizens only or can small businesses participate?
   d) What are the fees or incentives, if any, for participants?

2) Volume of CRTs received:
   a) How many (quantity or weight) CRTs have you received annually during the last 2 years? If you have monthly data or data going back to previous years, please include.
   b) How many (or) are televisions vs. computer monitors?
   c) How many (or) are from households? From small businesses? From donation centers? Other sources?

3) Has there been any significant change in the amount of CRTs received in the recent months?
   a) If yes, have you seen an increase or decrease? By how much?
   b) In your opinion, what do you think the reasons are for this change? Analog to digital TV signal conversion on February 17, 2009? Seasonal/events such as Christmas and Super Bowl? Other? Do you expect this trend to continue?

4) Processing CRTs:
   a) Please describe how the CRTs are processed (stored, sorted, recycled).
   b) Are any CRTs disposed rather than recycled? If so, why and how many (or)?
   c) Where are they sent for recycling? What is the frequency of shipments (weekly, monthly, quarterly, upon request)? What volume (quantity or weight) is sent?
   d) What is the cost of processing (handling, transportation, recycling fees, etc.)?

5) What is your collection capacity (i.e., limits on the number of CRTs that may be received and/or processed per week or month due to storage, handling, etc.)?

6) Although not directly related to CRT management, we are interested in other electronics that you may receive. How many (quantity or weight) computers have you received annually during the last 2 years? Please specify for desktop vs. laptops.

2009 Survey to Electronics Recycling Centers on CRT Recycling

Note: If you do not have actual data or percentages, please provide your best estimates and note this in your responses.

1) How are CRTs collected - Personal drop-off? Collection events? Municipal agreements/contracts? Commercial business accounts?

2) Volume of CRTs received:
   a) How many (quantity or weight) CRTs have you received annually during the last 2 years? If you have monthly data or data going back to previous years, please include.
   b) How many (or) are televisions vs. computer monitors?
   c) How many (or) are from households? Commercial? Donation centers? Other sources?

3) Has there been any significant change in the amount of CRTs received in the recent months?
   a) If yes, have you seen an increase or decrease? By how much?
   b) In your opinion, what do you think the reasons are for this change? Analog to digital TV signal conversion on February 17, 2009? Seasonal/events such as Christmas and Super Bowl? Other? Do you expect this trend to continue?

4) Requirements for incoming CRTs:
   a) Must they be disassembled? Or do you demanufacture at your facility?
   b) Are there minimum/maximum quantity requirements? If so, please describe.

5) What are your fees for receiving CRTs?

6) Process for recycling or demanufacturing CRTs at your facility:
   a) Please describe how the CRTs are recycled or demanufactured. What components or materials are separated?
   b) Are any items sent to landfills? If so, which items and how many?

7) Where are the following parts or materials sent? Please specify and to which state or country they are sent and to the type of facility (such as lead smelter; glass, metals, or plastics recycler; or electronics manufacturer).
   a) Leaded glass
   b) Cones
   c) Electron guns
   d) Circuit boards
   e) Cables
   f) Metals (steel, etc.)
   g) Plastics

8) Capacity:
   a) What is your collection capacity (i.e., limits on the number of CRTs that may be received per day, week, etc. due to storage availability)?
   b) What is your processing capacity per day or week? Please specify the constraints.

9) Although not directly related to CRT management, we are interested in other electronics that you may receive. How many (quantity or weight) computers have you received annually during the last 2 years? Please specify for desktop vs. laptops.

2009 Survey to Donation Centers on CRT Management

Note: If you do not have actual data or percentages, please provide your best estimates and note this in your responses.

1) How are CRTs collected?

2) Volume of CRTs received:
   a) How many (quantity or weight) CRTs have you received annually during the last 2 years? If you have monthly data or data going back to previous years, please include.
   b) How many (or) are televisions vs. computer monitors?
   a) Distribution (quantity or) of CRTs collected - Residential? Commercial? Municipal?

3) Has there been any significant change in the amount of CRTs received in the recent months?
   a) If yes, have you seen an increase or decrease? By how much?
   b) In your opinion, what do you think are the reasons for this change? Analog to digital TV signal conversion on February 17, 2009? Seasonal/events such as Christmas and Super Bowl? Other? Do you expect this trend to continue?

4) Processing CRTs:
   a) Please describe how the CRTs are processed (stored, sorted, recycled).
   b) Are any CRTs disposed rather than recycled? If so, why and how many (or)?
   c) Where are they sent? What volume (quantity or weight) is sent?
   d) What is the cost of processing (handling, transportation, recycling fees, etc.)?

5) What is your collection capacity (i.e., limits on the number of CRTs that may be received and/or processed per week or month due to storage, handling, etc.)?

6) Although not directly related to CRT management, we are interested in other electronics that you may receive. How many (quantity or weight) computers have you received annually during the last 2 years? Please specify for desktop

Appendix B – Follow-up Surveys on CRT Recycling (Spring 2010)

The following surveys were sent electronically to county household hazardous waste managers and recycling center managers during January-February 2010.

Follow-up Survey on CRT Recycling to County Household Hazardous Waste Managers

Note: If you do not have actual data or percentages, please provide your best estimates and note this in your responses.

1) Method of CRT collection:
   If you had answered this survey during spring 2009, please let us know how any of the following have changed in the past year. If this is the first time you have responded to our surveys, please provide information for items (a)-(d) below.
   a) How are CRTs collected: Curbside pick-up? Drop-off centers? Collection events? Other (please explain)?
   b) How many (or weight or percentage) from each collection source? What is the frequency of each collection source?
   c) Do you collect from private citizens only or can small businesses participate?
   d) What are the fees or incentives, if any, for participants?

2) Volume of CRTs received:
   If you had answered this survey during spring 2009, please let us know how any of the following have changed in the past year. If this is the first time you have responded to our surveys, please provide information for items (a)-(c) below.
   a) How many (quantity or weight) CRTs have you received annually during the last 2 years (2009, 2008)? If you have monthly data or data going back to previous years, please include.
   b) How many (or weight) are televisions vs. computer monitors?
   c) How many (or weight) are from households? From small businesses? From donation centers? Other sources?

3) Has there been any significant change in the amount of CRTs received in the past six (6) months?
   a) If yes, have you seen an increase or decrease? By how much?
   b) In your opinion, what do you think the reasons are for this change? Analog to digital TV signal conversion on June 12, 2009? Seasonal/events such as Christmas and Super Bowl? Other? Do you expect this trend to continue?

4) Processing CRTs:
   If you had answered this survey during spring 2009, please let us know how any of the following have changed in the past year. If this is the first time you have responded to our surveys, please provide information for items (a)-(d) below.
   a) Please describe how the CRTs are processed (stored, sorted, recycled).

b) Are any CRTs disposed rather than recycled? If so, why and how many (or)?
c) Where are they sent for recycling? What is the frequency of shipments (weekly, monthly, quarterly, upon request)? What volume (quantity or weight) is sent?
d) What is the cost of processing (handling, transportation, recycling fees, etc.)?

5) What is your collection capacity (i.e., limits on the number of CRTs that may be received and/or processed per week or month due to storage, handling, etc.)? Has this changed in the past year?

6) Although not directly related to CRT management, we are interested in other electronics that you may receive. How many (quantity or weight) computers have you received annually during the last 2 years (2009, 2008)? Please specify for desktop vs. laptops.

Follow-up Survey on CRT Recycling to Electronics Recycling Centers

Note: If you do not have actual data or percentages, please provide your best estimates and note this in your responses.

1) How are CRTs collected - Personal drop-off? Collection events? Municipal agreements/contracts? Commercial business accounts?

2) Volume of CRTs received:
   a) How many (quantity or weight) CRTs have you received annually during the last 2 years (2009, 2008)? If you have monthly data or data going back to previous years, please include.
   b) How many (or weight) are televisions vs. computer monitors?
   c) How many (or weight) are from households? Commercial? Donation centers? Other sources?

3) Has there been any significant change in the amount of CRTs received in the past six (6) months?
   a) If yes, have you seen an increase or decrease? By how much?
   b) In your opinion, what do you think the reasons are for this change? Analog to digital TV signal conversion on June 12, 2009? Seasonal/events such as Christmas and Super Bowl? Other? Do you expect this trend to continue?

4) Requirements for incoming CRTs:
   If you had answered this survey during spring 2009, please let us know how any of the following have changed in the past year. If this is the first time you have responded to our surveys, please provide information for items (a)-(b) below
   a) Must they be disassembled? Or do you demanufacture at your facility?
   b) Are there minimum/maximum quantity requirements? If so, please describe.

5) What are your fees for receiving CRTs?

6) Process for recycling or demanufacturing CRTs at your facility:
   If you had answered this survey during spring 2009, please let us know how any of the following have changed in the past year. If this is the first time you have responded to our surveys, please provide information for items (a)-(b) below.
   a) Please describe how the CRTs are recycled or demanufactured. What components or materials are separated?
   b) Are any items sent to landfills? If so, which items and how many?

7) Where are the following parts or materials sent? Please specify and to which state or country they are sent and to the type of facility (such as lead smelter; glass, metals, or plastics recycler; or electronics manufacturer).
   If you had answered this survey during spring 2009, please let us know how any of the following have changed in the past year. If this is the first time you have responded to our surveys, please provide information for items (a)-(g) below.
   a) Leaded glass

b) Cones
c) Electron guns
d) Circuit boards
e) Cables
f) Metals (steel, etc.)
g) Plastics

8) Capacity:
   a) What is your collection capacity (i.e., limits on the number of CRTs that may be received per day, week, etc. due to storage availability)?
   b) What is your processing capacity per day or week? Please specify the constraints.
   c) Has any of this changed in the past year?

9) Although not directly related to CRT management, we are interested in other electronics that you may receive. How many (quantity or weight) computers have you received annually during the last 2 years (2009, 2008)? Please specify for desktop vs. laptops.

Appendix C – Detailed Summary of 2009 and 2010 Survey Responses

The following summarizes the responses to the spring 2009 and 2010 surveys provided by hazardous waste managers, recycling facility managers, and donation centers.

2009 and 2010 CRT Survey Results (monitor = computer CRT; TV = color television CRT) Updated 4.8.2010

County Household Hazardous Waste Managers

County	Collection	2007 Monitors	2007 TVs <19"	2007 TVs >19"	2008 Monitors	2008 TVs <19"	2008 TVs >19"	2009 Monitors	2009 TVs <19"	2009 TVs >19"	% mon, TVs	% household
Alachua (pop 241,000)	Collection centers (1 permanent 65%, 5 satellite locations 30%). 12 collection mobile events/yr 5%	550,000 lbs of CRTs/yr			550,000 lbs of CRTs/yr						60% monitors	70% household, 30% business
2010 Alachua (pop 241,000)	SAME. 6 county collection sites as well as during mobile HHW collection events, ~12/year and from 8 Coop collection events in neighboring counties.							170,000 lbs of CRT for 6 months since last survey			Higher % of TVs from last survey, now running 50%-50% quantity.	85% household, 15% businesses
Broward (pop 1,751,000)	Curbside for City of Oakland Park. Drop-off centers. 14 collection events/yr	11008	987	2450	12678	1840	3352				75% monitors	~70% household

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County	Changes #?	Reasons for Changes#	Fees, costs	Processing	To Landfill	CRTs sent to	Capacity	Destops/ laptops
Alachua (pop 241,000)	~15% increase in past years		Collection fees: free for residents, for businesses $2.50 or $3.50/monitor, $7 or $11/TV. Price: $6 or $8/TV. $3/monitor over 19"	Store, palletize/shrink wrap and place in box trailer until contractor transports. Shipped every 2-3 weeks in a 45' trailer (upon request). ~ 20,000-25,000 lbs per trailer	None	Creative Recycling Systems, Tampa, FL	None	120,000 lbs of computers, 95% computers
2010 Alachua (pop 241,000)	Increased by ~5-10%	Continue with the lowering of pricing of plasma and LCD technology	Fees: free for households, fee for businesses and institutions ($2.50/$3.50 monitors, $7.00/$11.00 TV's, remainder of E-scrap no charge for businesses). Processing cost: monitors <=19" are N/C, over 19" are $3, small TVs are $6.00, large TVs are $8.00, projection TVs are $20, console/floor TVs are $15	No changes since 2009 survey	None	Creative Recycling Systems, Tampa, FL, every ~3 weeks with a 45' trailer	None	Approximately 90,000 pounds annually, 95% desktops
Broward (pop 1,751,000)	60% increase in TVs for Q1 of FY09 compared to Q1 FY08. 20% increase overall		Materials Recycling Fees: Monitors $6, TVs >19 $12, TVs < 19 $8 each. Administrative allocation of 10% and truck and labor charges averaging $40/hour	Sorted, palletized, wrapped. Sent to Creative Recycling (512/wk in Feb 2009) and America Electronics Recycling (903/wk in Feb 2009)	None	Creative Recycling, Tampa, FL, and America Electronics Recycling	50% more than current	

County	Collection	2007 Monitors	2007 TVs <19"	2007 TVs >19"	2008 Monitors	2008 TVs <19"	2008 TVs >19"	2009 Monitors	2009 TVs <19"	2009 TVs >19"	% mon, TVs	% household
2010 Broward (pop 1,751,000)	No change since 2009 survey. Receive from residents, government, small businesses	FY07: 7064 units, 211,920 lbs from residents; 2358 units, 70,740 lbs from govt; 1580 units, 47,400 lbs from sm biz. Total: 11,002 units, 330,060 lbs	FY07: 872 units, 30,520 lbs from residents; 44 units, 1540 lbs from govt; 10 units, 350 lbs from sm biz. Total: 926 units, 32,410 lbs	FY07: 1971 units, 137,970 lbs from residents; 323 units, 22,610 lbs from govt; 14 units, 980 lbs from sm biz. Total: 2308 units, 161,560 lbs	FY08: 7620 units, 228,600 lbs from residents; 1890 units, 56,700 lbs from govt; 1559 units, 46,770 lbs from sm biz. Total: 11,069 units, 332,070 lbs	FY08: 1457 units, 50,995 lbs from residents; 73 units, 2,555 lbs from govt; 9 units, 315 lbs from sm biz. Total: 1539 units, 53,865 lbs	FY08: 2701 units, 189,070 lbs from residents; 410 units, 28,700 lbs from govt; 13 units, 910 lbs from sm biz. Total: 3124 units, 218,680 lbs	FY09: 8862 units, 265,860 lbs from residents; 1417 units, 42,510 lbs from govt; 1055 units, 31,650 lbs from sm biz. Total: 11,334 units, 340,020 lbs	FY09: 3381 units, 118,335 lbs from residents; 506 units, 35,420 lbs from govt; 29 units, 1,015 lbs from sm biz. Total: 3916 units, 154,770 lbs	FY09: 4372 units, 11,432 lbs from residents; 196 units, 6,860 lbs from govt; 42 units, 2,940 lbs from sm biz. Total: 4610 units, 21,232 lbs	FY09: 66% monitors by weight	FY09: 77% residents by weight
Charlotte (pop 142,000)	2 drop-off centers, county residents only	116,955 lbs total			154,458 lbs total						75% monitors	100% household
2010 Charlotte (pop 142,000)	2 drop-off centers, county residents only	FY06/07: 2159			FY07/08: 2530			FY08/09: 4059			47% monitors, 53% TVs	100% household
Citrus (pop 118,000)	1 drop-off at central landfill, residents and small businesses	1383		4589	955		4995				~30% monitors	85% household, 10% donation centers, 5% small business
2010 Citrus (pop 118,000)	No change since 2009 survey											

County	Changes #?	Reasons for Changes#	Fees, costs	Processing	To Landfill	CRTs sent to	Capacity	Destops/ laptops
2010 Broward (pop 1,751,000)	Continuing to increase, but not as dramatic as last year	Digital TV signal conversion in 2009, Seasonal events such as Christmas and Super Bowl.	Same as in 2009	Same as in 2009	None	Creative Recycling, Tampa, FL, and America Electronics Recycling	No changes since 2009 survey	Started tracking Dec 2009
Charlotte (pop 142,000)	32% increase		Cost: $3/monitor, $5/small TV (<21), $8/large TV (>21")	Stored, sent to Creative Recycling	None	Creative Recycling Systems, Tampa, FL	1 30 cu yd roll-off container at each of 2 drop-off	2007: 14,277 lbs. 2008: 18,376 lbs
2010 Charlotte (pop 142,000)	Increase starting in 2008		Fees: $0. Cost: $800/roll-off container	Store in roll-off containers for recycler pick-up. 5.5 tons per roll-off container. 163 tons shipped in FY08/09	None	Creative Recycling Systems, Tampa, FL, upon request	No limits on collection	FY 08/09-1315 cpu's, FY 07/08-448 cpu's, FY 06/07-449 cpu's
Citrus (pop 118,000)	50% increase		Fee: residents 4 free/yr. More or business: $8/each. Cost: $6/CRT if >19"	Stored, sent weekly to Creative Recycling Systems	None	Creative Recycling Systems, Tampa, FL	1 40 yd roll-off container	~500 computers, 90% desktops
2010 Citrus (pop 118,000)	Slight increase in both TV and monitor CRTs	Increase occurred around the time of announcements for the analog to digital changeover (late 2008) and is now slowly returning to norma. Recently, the amount of non-CRT televisions, such as LCD and plasma, have increased.		No changes since 2009 survey			No changes since 2009 survey	No changes since 2009 survey

County	Collection	2007 Monitors	2007 TVs <19"	2007 TVs >19"	2008 Monitors	2008 TVs <19"	2008 TVs >19"	2009 Monitors	2009 TVs <19"	2009 TVs >19"	% mon, TVs	% household
Escambia (pop 294,000)	Drop-off and collection events	367 tons of electronics (~70% CRTs)									35% monitors	50% household for monitors, 100% household for TVs
Hendry (pop 39,000)	Drop-off centers for household residents			6-15-07: 22 TVs	2-8-08: 5 monitors 7-cpu; 6-23-08: 34 monitors 7-cpu; 11-20-08: 28monitors 7-cpus		2-8-08: 21 TVs, 6-23-08: 18 TVs, 11-20-08: 25 TVs				86 TVs, 67 monitors	100% household
2010 Hendry (pop 39,000)	Drop-off centers								217 units in past 2 years		115 TVs, 92 monitors	90% households, 10% small business
Lee (pop 441,000)	Curbside for residential, drop-off for residential and business	9641		15,362	7821		17,052				~35% monitors	65% household
Leon (pop 239,000)	Drop-off centers at landfill and rural sites. Collection events	489 tons of electronics (2006: 7819 TVs, 5228 monitors)										Mostly households

County	Changes #?	Reasons for Changes#	Fees, costs	Processing	To Landfill	CRTs sent to	Capacity	Destops/ laptops
Escambia (pop 294,000)	~10% increase		Fee: free no limit. Cost: $10/TV, 0/monitor	Stored, packaged, 2-4 loads (53-ft trailers) per month to Creative Recycling	None. To Class I landfill if item has been through flood or fire or face-plate is damaged.	Creative Recycling Systems, Tampa, FL. Previously to Unicor	None	~30% of 367 tons/yr in computers and electronics
Hendry (pop 39,000)	No - same		Fee: $0; Cost: $0	Stored in H.H.W. storage container. The day before pick up, sort and stack on pallets and shrink wrap. Pick-up on request.	None	Creative Recycling Systems, Tampa, FL	Depends on size; put together 4 or 5 pallets before calling for pick-up	2-8-08: 7 cpu; 6-23-08: 7 cpu; 11-20-08: 7 cpu
2010 Hendry (pop 39,000)	65% increase	Analog to digital TV signal conversion	Fee: $0; Cost: $0	Recycled; CRTs placed on pallets for shipment	None	Creative Recycling Systems, Tampa, FL, upon request	300 units. No changes since 2009 survey	2009= 29, 2008= 14; received 2 laptops since 2008
Lee (pop 441,000)	Slight TV increase in 2008		Fee: free for residents, $10/TV $8/monitor for business	Palletize. Ship 2 tractors trailer loads /week to American Electronics Recycling (Sarasota) and Creative Recycling. They don't ship intact out of country.	Some businesses dispose in dumpsters	American Electronics Recycling, Sarasota and Creative Recycling Systems, Tampa	None	2007: CPUs 4527, laptops 324. 2008: CPUs 3724, laptops 309. #CPUs went down because price of metals increased for metal recyclers
Leon (pop 239,000)	No significant change		Fees: $0 for residents, $75/ton for business. Costs: $119,000 in 2007, $117,000 in 2008 overall	Sorted, put on pallets and shrink-wrapped and placed on tractor trailers. Sent to Creative Recycling once/week	None	Creative Recycling Systems, Tampa, FL	None	2006: 1881 CPUs, 124 laptops

County	Collection	2007 Monitors	2007 TVs <19"	2007 TVs >19"	2008 Monitors	2008 TVs <19"	2008 TVs >19"	2009 Monitors	2009 TVs <19"	2009 TVs >19"	% mon, TVs	% household
2010 Leon (pop 239,000)	Drop-off centers at landfill and rural sites. Collection events				2915 units	2476 units	3144 units	151,562 lbs, 4225 units	2009: 225,169 lbs., 5705 units. Jan 2010: 26,203 lbs, 459 units	2009: 204,046 lbs., 4705 units. Jan 2010: 21723 lbs, 267 units		Mostly households (~80%, 20% businesses). Businesses bring in at 10:1 ratio; Get all TVs in the county since Goodwill does not accept TVs (sends them directly to Creative Recycling recently; but county pays for it) but will accept computer monitors.
Orange (pop 1,066,000)	Drop-off, 4 collection events/yr	CRTs 320,395 lbs			179,771+33,339 lbs collected. 323,138 lbs of CRTs	297,053+ 66,679 lbs collected					20% monitors, 40% TVs	100% household
2010 Orange (pop 1,066,000)	Curbside pick-up, Drop-off centers, Collection events. CRTs are collected at the Young Pine Rd permanent facility and four HHW Community Collection Events. Residents only					472,671 lbs electronics		576,340 lbs of electronics. In Jan 2010, 41,220 lbs of electronics				100% household

County	Changes #?	Reasons for Changes#	Fees, costs	Processing	To Landfill	CRTs sent to	Capacity	Destops/ laptops
2010 Leon (pop 239,000)	No significant change		Fees: $0 for residents, $75/ton for business. Costs in FY 2009: $57,416 to Creative Recycling (but some of FY09 expenses was billed in 2010	Same - Sorted, put on pallets and shrink-wrapped and placed on tractor trailers. Sent to Creative Recycling once/week	Fees: $0 for residents,		At rural centers, 1 40-yd roll-off container. No capacity limits at main drop-off center. Will call Creative if need pick-up more frequently	
Orange (pop 1,066,000)	0.85% increase, slight increase after Christmas		Fees: $0 for residents, $0.50/lb for CESOG's. Costs: $0 for TVs, county receives $0.01/lb for monitors	Sent ton contractor for recycling, 1,323-3,896 lbs of CRTs weekly	Households exempt and can dispose of CRTs in garbage. County encourages and promotes recycling as a preferred option for disposal	Creative Recycling Systems, Tampa, FL	None, picked up weekly	83,758 lbs of computers
2010 Orange (pop 1,066,000)	From 2007-2008, 31% increase; from 2008-2009, 22% increase for all categories	Digital TV signal conversion in 2009, Seasonal events such as Christmas and Super Bowl. Expect increase trend to continue.	Fees: No fees, voluntary drop-off only. Processing: get paid $0.01/lb for all electronics	CRT are received at the HHW facility and either palletized on stored in Gaylord boxes	Curbside units are picked-up by haulers from homeowners and disposed as Solid Waste	Creative Recycling Systems, Tampa, FL, twice weekly	15 to 20 Pallets	

County	Collection	2007 Monitors	2007 TVs <19"	2007 TVs >19"	2008 Monitors	2008 TVs <19"	2008 TVs >19"	2009 Monitors	2009 TVs <19"	2009 TVs >19"	% mon, TVs	% household
2010 Pasco (pop 463,000)	2 drop-off locations, 1 electronics collection event/year. The 2 drop off locations combined yielded 10,946 CRTs and the amnesty event resulted in 1,175 CRT units (689 TVs and 486 monitors).				559,493 lbs CRTs: 15.55% y weight, 19.18% by unit		559,493 lbs CRTs: 67.92% by weight, 42.47% by unit	714,644 lbs CRTs: 11.01% by weight, 16.49% by unit		714,644 lbs CRTs: 77.80% by weight, 58.96% by unit	16-19% monitors, 42-59% TVs	household and business
Pinellas (pop 924,000)	1 drop-off center and complete 18 mobile collections. Small collections at mobile homes, condo's, subdivisions and other concentrated residential areas; can be scheduled 3x a week Sept-June Also collect once a month from Conditionally Exempt Small Quantity Generators (CESQGs), who deal directly with contractor.	FY 06/07: 7600 units = 257,721 lbs		FY 06/07: 7347 units = 522,410 lbs	FY 07/08: 7561 units = 204,008 lbs		FY 07/08: 9249 units = 460,737 lbs				30% monitors, 70% TVs (by weight)	100% household (50% from each source drop-offs and small collections).

County	Changes #?	Reasons for Changes#	Fees, costs	Processing	To Landfill	CRTs sent to	Capacity	Destops/ laptops
2010 Pasco (pop 463,000)	Slight increase (~15%) in the total annual collections from 2008 through 2009	Until the end of 2008, received large numbers of console TVs. In 2009, mostly projection TVs and fewer console TV, attributing to overall increase in 2009.Age of the units is a factor. Other reasons: decrease of in price of the flat panel TV; high foreclosures in Pasco; out of businesses electronics mom and pop stores; Self Storage businesses bringing in the EEE because renters did not pay rent.	Fees: $5/unit for computers, monitors, TVs for residents; $200/ton for businesses; up to 2 free CRTs during collection event. Cost of processing: dismantling and on-site management: $2,100/month; Cost of transportation: $50.00/shipment; Cost of recycling: $0.10/lb	All console and projection TVs are dismantled on site (to save money on weights), they are packed in Gaylord boxes, shrink wrapped and transported to Tampa for processing where the electronic guns are removed, the CRTs are shredded and shipped out to smelters. Regular TVs are sent to Tampa intact. In Tampa they are tested, some is repaired and sold on site or on EBay. Those that are not repairable are crushed and sent to smelters	No	Weekly (5000 lbs/wk) to PA. However, smelters are changed every once in a while due to economical conditions	None	Mostly desktops: 2008= 1,678 computers (41,719 lbs); 2000= 1,076 computers (26,529 lbs)
Pinellas (pop 924,000)			Fees: $0 for residents; businesses utilize county's contracted prices.					FY 06/07: 5465 units = 126,720 . BY 07/08: 5893 units = 105,628 lbs

County	Collection	2007 Monitors	2007 TVs <19"	2007 TVs >19"	2008 Monitors	2008 TVs <19"	2008 TVs >19"	2009 Monitors	2009 TVs <19"	2009 TVs >19"	% mon, TVs	% household
2010 Pinellas (pop 924,000)	One permanent drop-off center, 18 large collections and about 25-30 small neighborhood collections. We collect form private citizens but also provide an outlet for businesses. Once a month a collection is held at our center and businesses may also bring their Items to any of our 18 mobile collections. These are handled directly by our contractors.				FY07/08: 232,343 lbs. of monitors.		FY07/08: 572,607 lbs. of televisions	FY08/09 (Oct 08-Sept 09): 257,336 lbs. FY10 1Q: 20,875 lbs.		FY08/09: 827,484 Lbs. FY10 1Q: 62,458 lbs	~60% wereTVs in 07/08. ~70% were TVs in 08/09. Between center and collections TV's are about 50/50 and monitors are about 30/60.	100% household. All of these are household. Items collected from businesses are handled by our contractors and taken directly to their facilities
Putnam (pop 70,000)	1 drop-off center	Data not available (don't track)										
Sarasota (pop 326,000)	Curbside and 3 drop-off centers	don't track as contract is per pound										

County	Changes #?	Reasons for Changes#	Fees, costs	Processing	To Landfill	CRTs sent to	Capacity	Destops/ laptops
2010 Pinellas (pop 924,000)	A little increase	Digital TV signal conversion in 2009, Seasonal events such as Christmas and Super Bowl. Drop in flat-screen TV prices.	Costs: TV $0.15/lb, monitors $0.05/lb	TVs and monitors are stored and sent off still intact. Our monitors are stacked on pallets; shrink wrapped and sent off to our contractor's facility in a semi-trailer. Our televisions are loaded into a 40-yard roll-off container and picked up twice a week.	None	Creative Recycling in Tampa, FL. Twice a week. Approx. 6,500 lbs of televisions per pickup.	Had to add more pickups in recent months.	Collected 139,220 lbs of CPU's and laptops in 2009
Putnam (pop 70,000)			Fees: 0. Costs not available	Picked-up by e-waste recycler. Short semi-trailer, recycler picks up when full.	Don't know		None	
Sarasota (pop 326,000)			Fees: $0 for residents, $0.15/lb for business. Costs: varies	County sorts, packages for shipment. Processed at vendor's facility. Creative Recycling picks up weekly	None	Creative Recycling Systems, Tampa, FL	Waste permit limits use to storing no more than 1000 units at a time and electronics must be removed monthly	

County	Collection	2007 Monitors	2007 TVs <19"	2007 TVs >19"	2008 Monitors	2008 TVs <19"	2008 TVs >19"	2009 Monitors	2009 TVs <19"	2009 TVs >19"	% mon, TVs	% household
2010 Sarasota (pop 326,000)	Curbside, Drop-off Centers, and at collection events. Curbside collects 80% (967,585 pounds from curbside in 09) of the electronics that come into our program. Facilities/Events collected 266,291 pounds in 09. Curbside is available 5 days/week, 52 weeks/year. Two collection facilities available for 8 hrs/day for 203 days in 2009, and one facility available 9 hrs/day for 309 days in 2009. Special events vary from year to year, but we had 43 special events in 2009.				2008: 73 % (861,659 pounds of CRT's) were CRTs			2009: 86% (1,057,180 pounds of CRT's) were CRT's			20% monitors, 80% TVs	
Seminole (pop 365,000)	Drop-off center (95%) and one collection event annually (5%)	FY07=3,505 CRTs, 2277 monitors		FY07 1228 TVs	FY08=3,645 CRTs, 2125 monitors		FY08 1520 TVs				~60% monitors	100% household
2010 Seminole (pop 365,000)	No change since 2009 survey							FY09=4531 CRTs, 2044 monitors		FY09 2488 TVs		100% household
Donation Centers												

County	Changes #?	Reasons for Changes#	Fees, costs	Processing	To Landfill	CRTs sent to	Capacity	Destops/ laptops
2010 Sarasota (pop 326,000)	Increase	Both Digital switchover and Christmas. I see no indication of this trend changing. I still get amazed at the volumes of electronics we see	Cost: Residents do not pay at time of disposal as they pay for the programs as part of their solid waste assessment. Businesses can dispose of electronics and currently pay $0.15/pound at the time of disposal	CRT's are sorted (TV's from Computer Monitors) and palletized for recycling by a vendor.	None	Creative Recycling, Tampa, FL. Pickups from two of our three facilities. One facility is scheduled every other week with additional pickups scheduled as needed. The curbside consolidation facility is picked up weekly with additional pickups scheduled as needed. The curbside consolidation facility ships approximately 13,000 lbs on average each shipment; other facility ships approximately 6,000 lbs on average each shipment.	Never exceeded capacity at any facility due toregularly scheduled pickups and availability to call for additional pickups when necessary. The curbside consolidation facility has a pad that can accommodate ~60 pallets before we run out of processing space.; same at primary collection center.	2009: 1200 pounds of laptops and 31,672 pounds of CPU's. 2008: 40,522 of CPU's and 2101 pounds of laptops.
Seminole (pop 365,000)	No		Fees: $0 for residents, $1/monitor, $5/TV for businesses to contractor directly. Costs: $5/TV, $1/monitor	Stored, then sent to Great Lakes Electronics/Almet. Shipments are monthly or sometimes more frequently	None	Great Lakes Electronics/Almet	None	s
2010 Seminole (pop 365,000)	Yes, increase by approx 1000 CRTs in FY09 compared to FY08, and continuing increase	Analog to digital TV signal conversion		No changes since 2009 survey				FY09=2,222 total: Desktops=2,023 Laptops=199
Donation Ce								

County	Collection	2007 Monitors	2007 TVs <19"	2007 TVs >19"	2008 Monitors	2008 TVs <19"	2008 TVs >19"	2009 Monitors	2009 TVs <19"	2009 TVs >19"	% mon, TVs	% household
Goodwill Big Bend	Donation centers in North FL and South GA	1.25 millions lbs of CRTs			1.75 million lbs of CRTs						35% monitors	90% household, 7-8% Commercial, 2-3% Municipal

Electronics Recycling Centers

Name	Collection	2007 Monitors	2007 TVs <19"	2007 TVs >19"	2008 Monitors	2008 TVs <19"	2008 TVs >19"	2009 Monitors	2009 TVs <19"	2009 TVs >19"	% mon, TVs	% household
A-1 Assets, Longwood, FL www.a1assets.com	Municipal and business contracts, some collection events	6305		427	7799		459				95% monitors	1% household, 99% commercial
2010 A-1 Assets, Longwood, FL www.a1assets.com	Personal drop-off, Collection events, Municipal agreements/contracts, Commercial business accounts				8258 CRTs			6807 CRTs			~95% monitors, 5% TVs	1% household, 99% commercial

County	Changes #?	Reasons for Changes#	Fees, costs	Processing	To Landfill	CRTs sent to	Capacity	Destops/ laptops
Goodwill Big Bend	20-35% increase		Costs: full-time position for packaging, labor hours for handling/ transporting. Some partners charge	Tested, resale/reuse if working, or sent to e-cycling partners, require a certificate of proper recycling be submitted	None	Creative Recycling, USA Liquidators, and UNICOR	Limited storage, take to recyclers when full	~3-3.5 millions lbs of electronics/yr

Electronics

Name	Changes #?	Reasons for Changes#	Fees	Processing	To Landfill	Parts sent to	Capacity	Destops/ laptops
A-1 Assets, Longwood, FL www.a1assets.com	No		$3/monitor, $0/working TV, $10 25/TV	Pallets to send for demanuf CRTs; demanuf computers and other electronics	wood, particle board, rubbish	American Electronics Recycling, Sarasota	2000/month	125% computers/CRTs. 98% desktops, 2% laptops
2010 A-1 Assets, Longwood, FL www.a1assets.com	Decrease of 30% or more	CRT Monitors in the workplace	$3/CRT for processing	All CRT's are sent through a triage process. Any CRT that has screen scratches, has missing bases, are older than 10 years old, have screen burns, or do not work 100% are sent to American Electronics Recyclers in Sarasota for disassembly and recycling.	None	Whole units are sent to American Electronics Recycling in Sarasota, FL	Have not reached that point so not sure, but probably a couple thousand per month would be the most we could reasonably handle. No change since 2009 survey.	2008= 4600 (320 of which are laptops); 2009= 3800 (268 of which are laptops)

County	Collection	2007 Monitors	2007 TVs <19"	2007 TVs >19"	2008 Monitors	2008 TVs <19"	2008 TVs >19"	2009 Monitors	2009 TVs <19"	2009 TVs >19"	% mon, TVs	% household
2010 E-scrap, Hialeah, FL www.escrapusa.com	90% of CRTs are collected through municipal agreements, the remaining 10% are received from commercial accounts, collection events, commercial business and individual drop-off	18,260		5035	16,554		5513	21,339		21,908		75% households through municipal; 25% commercial and individual drop-offs
2010 SIR International, Opa Locka, FL; www.sircompany.com.br/us/empresa.php	Average collection of CRT= 2,000 units/month: Personal Drop Off= 120 units/month; Collection Events= 400 units/month; Municipal Agreement= 180 units/month; Commercial Business= 1,300 units/month				28,000 total CRTs			24,000 total CRTs			75% Monitors, 15% TVs, 10% Terminals	12% Households, 85% Commercial, 3% Donation
Southeastern Data, Oviedo, FL www.southeasterndata.com	Drop off, collection events, commercial accounts	several thousand total			several thousand total						99% monitors	TVs: 99% household, 1% commercial

County	Changes #?	Reasons for Changes#	Fees, costs	Processing	To Landfill	CRTs sent to	Capacity	Destops/ laptops
2010 E-scrap, Hialeah, FL www.escrapusa.com	Sharp increase (double) in CRT disposal in 2009 over 2008; the trend so far in 2010 seems to have stabilized at the 2009 rate, even though it is still too early to identify since economic recovery might witness an increase in television disposal.	Increase in municipal collection sites over 2008; digital TV transition; sharp drop in prices of LCD-monitors and flat screen TVs		CRTs generally are collected or received intact and are then demanufactured in the facility. All components from CRTs are manually separated: plastic casing, cables, electron gun, yoke, metal frame and glass; each component is broken down, loaded in industrial grade containers or baled, and shipped to specialized processors (see Electronics Recycling Methodology dated 1/01/2010, for more information regarding processes). Working items sent to markets in Latin America and the Caribbean.	Wood from consoles (3-5%)	Leaded glass: GtoG processor in Mexicali, CA and Atlanta, GA Yokes - copper processor, Miami, FL Electron gun - metal recycler, Miami, FL Circuit boards and cables - recycler, Morristown, NJ Metals – metal scrapper, Miami, FL Plastics – plastic scrapper, Miami, FL Ink and toner cartridges - recycler, Miami, FL	CRT Collection/receiving capacity: 75>90+ units/day; CRT Processing: 80+ units/day Constraints: manpower increase and longer shifts = costs	
2010 SIR International, Opa Locka, FL; www.sircompany.com.br/us/empresa.php	Decrease	The volume has reduced and also the market has stop buying electronics due to the economy (no updates, or companies out of business)	$0 if it comes with other computer units, if not $10.00/unit	Separated by size, color, type and condition. Then palletized and shrink-wrapped. The market has changed for us, before we use to disassemble the monitor/TV/Terminal, now the companies want to receive the whole thing. The reason for that is simple, they want to make more money with the components, boards, wire and plastic and/or transform the monitors into cheap TV's. Need at least 840 units to fulfill a container load.		Sold to "local market"; also to Peru	2000-2500 units/day	Computers= 30%, Printers= 35%, UPS= 5%, Telephones= 8%, Cables= 12%, Others= 10%
Southeastern Data, Oviedo, FL www.southeasterndata.com	Noticeable decrease in monitors		$7/monitor, $0.50/lb TV	Do not demanufacture. TVs are either sent to processors for a fee, or are provided to repair shops to repair and resell	office refuse	Domestic processing facilities, or sold to commodities brokers that rep for processing facilities in other countries, usually Asia	None. Test hundreds of TVs/day	~3000/year, 75% desktops

County	Collection	2007 Monitors	2007 TVs <19"	2007 TVs >19"	2008 Monitors	2008 TVs <19"	2008 TVs >19"	2009 Monitors	2009 TVs <19"	2009 TVs >19"	% mon, TVs	% household
2010 Southeastern Data, Oviedo, FL www.southeasterndata.com	Drop offs, collection events, commercial business accounts				~8000 CRTs			~3000 CRTs			95% monitors	99% business
Technology Conservation Group, Lecanto, FL and elsewhere www.tcgrecycling.com	Mostly large commercial businesses. Some drop-offs, collection events, FL school districts and municipalities	424,003 monitors; 39,379 CRTs		72	104,458 monitors; 69,616 CRTs		46				99.9% monitors	0.1% households, 85% commercial, 14.9% schools and municipal
UNICOR, Marianna, FL	Municipal and commercial/govt	33,540 CRTs			29,500 CRTs						60% monitors	5% households, 80% commercial/govt, 15% donation centers

County	Changes #?	Reasons for Changes#	Fees, costs	Processing	To Landfill	CRTs sent to	Capacity	Destops/ laptops
2010 Southeastern Data, Oviedo, FL www.southeasterndata.com	Decrease ~60%	Decrease in computer monitor CRTs is the extremely low prices of LCD monitors and users upgrading to them. CRTs will soon disappear from the market as computer displays. The digital conversion was a non-issue; most viewers use cable boxes.	TVs are $0.50/lb, CRTs are generally accepted at no charge from our accounts, because we're still able to sell them	No change since 2009 survey. 2 years ago I remember selling CRTs by the pallet, now it's only possible by the container load	None	Monitors are sold whole to EPA approved CRT recyclers for export	1000 in a single day and possibly another 1000 that week. Depends on what other operations are going on; CRTs are not the only material we recycle.	~10,000 computers/year, with ~3000 laptops
Technology Conservation Group, Lecanto, FL and elsewhere www.tcgrecycling.com			$0.15-0.25/lb	Demanufacture	None	Intact CRT to glass recycler in Ohio. Metals to processor in Tampa. Circuit boards to primary smelter in Canada. Plastics to processor in IL.		2007: 85,675 computers for resale. 2008: 0 computers
UNICOR, Marianna, FL	15-25% increase		$0 for public, govt. $5-7/each	Demanufacture	None	Leaded glass to MD. Cones & cables to MD, IL. Metals to FL, AL, IL. Plastics to FL.	No limits currently. Demanuf 125-175 CRTs/day	Desktops 500,000 lbs/yr; laptops 75,000 lbs/yr