

Electronic Waste Programs in Other States

Residual Material Disposition and Oversight

I. Purpose

The purpose of this draft overview is to provide background information on electronic waste (e-waste) recycling programs in other states, with an emphasis on the disposition of derived residuals and any associated oversight conducted by state authorities. The area of focus is specifically on how programs manage cathode ray tube (CRT) glass residual waste. CRT glass derived from the management of e-waste materials presents an increasingly complex disposition challenge for both California's e-waste efforts and those in other states. Due to the fundamental differences between other states' approaches and California, understanding program operations, market conditions, applicable laws, and regulatory oversight is necessary. This overview is a working document and was prepared as a general information item to inform future policy considerations. It was first made available as a resource at a stakeholder workshop hosted by CalRecycle on May 12, 2015¹.

II. Background

California passed its Electronic Waste Recycling Act in 2003. Since then, 24 other states have enacted some form of electronic (e-waste) recycling law, with 18 of those including an affirmative ban on the disposal of specified electronic devices and/or derived residual materials. Apart from law, some states have grant programs to encourage proper management of the materials.

California is unique among state programs in that all e-waste regardless of generator sector is presumed hazardous and, therefore, may not be disposed with municipal solid waste. The California Department of Toxic Substances Control (DTSC) regulates the physical management of hazardous waste in the state, including e-waste in general, covered electronic waste (CEW) in particular, and certain residuals derived from the dismantling / processing (treatment) of e-waste, such as CRTs and CRT glass.

There are generally two types of CRT glass; panel glass, often described as non-leaded but can contain approximately 2 percent lead, and funnel glass containing approximately 40 percent lead. California law considers panel glass to be hazardous because of total concentrations of barium, while lead-rich funnel glass is a federally recognized hazardous material.

III. California's Electronic Waste Recycling Program

California's CEW recycling program provides funding to authorized collectors and recyclers to recover and process CEW in state. It is administered by the Department of Resources Recycling and Recover (CalRecycle) and targets video display device such as televisions and computer monitors. Financing for the program is through a fee assessed on consumers at the retail sale of new covered devices. Over the ten-year operational life of the program, an average of 180 million pounds of CEW has been cancelled and claimed annually. More than 97% by weight of that material has been CRT devices.

In order for recyclers to receive program funds, they must submit claims that assure they have processed material and managed the residuals properly. In particular, recyclers must demonstrate that they have shipped all derived residual CRTs and/or CRT glass to a destination authorized to receive and further treat that material. To ensure compliance with applicable laws, the ultimate disposition for the nearly 100 million pounds of CRT glass generated annually in California is monitored by both DTSC and CalRecycle. Market options for CRT glass are restricted by regulatory

¹ <http://www.calrecycle.ca.gov/Actions/PublicNoticeDetail.aspx?id=1443&aiid=1311>

considerations and have traditionally been limited to lead smelting and CRT manufacturing. Over the last few years, approximately 85% of CRT glass derived from the CEW program has flowed, directly or indirectly, to India, ostensibly for consumption in CRT manufacturing. The remainder has flowed to existing or anticipated domestic smelting operations.

Both DTSC and CalRecycle have authority to take enforcement actions against recyclers who handle and ship CRTs and CRT glass if the ultimate disposition of that material violates conditions of authorization under which those entities operated.

IV. Other State E-Waste Programs

The following general and specific information about e-waste recycling program in other states was compiled through literature review, state agency websites, and direct communication with state agency personnel responsible for and knowledgeable about program details. Sources are cited and/or footnoted as applicable.

General Key Programmatic Areas

Unlike California's CEW recycling program that is funded by consumer fees and administered by state payments, most e-waste laws in the rest of the United States are structured under various forms of an Extended Producer Responsibility (EPR) model. EPR, sometimes also known as Product Stewardship, is a strategy to place a shared responsibility for end-of-life product management on the producers, and all entities involved in the product chain, instead of the general public; while encouraging product design changes that minimize a negative impact on human health and the environment at every stage of the product's lifecycle. It places primary responsibility on the producer, or brand owner, who makes design and marketing decisions and designs end-of-life management systems through a stewardship organization. Basic provisions of EPR legislation are explained in CalRecycle's EPR checklist². Information about collection rates across state e-waste programs can be found in Figure 2 of the Appendix.

The participating parties and roles in e-waste EPR programs are generally as follows:

Original equipment manufacturers (OEM) are responsible for paying for the collection, recycling, and/or processing of a determined share of generated devices covered by the program. The OEMs or an associated consortium contract with recyclers to meet these responsibilities and submit their plan to a government body. These plans lay out how material will flow from generators of waste through proper channels and managed appropriately.

Contracted **recyclers** act as the handler, collector, and recycler of the material. They generally do not do much more than consolidate the material – few are cancelling devices or breaking then sorting glass. They get funded by agreements and plans in cooperation with OEMs. They typically operate under independent third party standards of R2 or e-Stewards. These standards often meet the requirements of the government department that oversees/monitors the recyclers.

A **government department** imposes and monitors reporting requirements on manufacturers and/or recyclers, focusing primarily on the amount collected and whether targets have been met. Formulas take market share percentage and create a collection amount target for the year. As part of the plan, recyclers divulge where they intend to ship the material, but do not need to track the status of material flow with the prearranged downstream parties. There may be annual fees due to the department by the OEMs/recyclers. Downstream assurances are nearly always handled via third

² <http://www.calrecycle.ca.gov/EPR/Resources/ChecklistOv.doc>

party frameworks of R2 and/or e-Stewards. United States Environmental Protection Agency (US EPA) recognizes these programs as the two accredited certification standards that exist to advance best management practices.³

Residual Management Summary

What do recyclers do with the collected CRT glass?

Currently, most CRT glass generated in the United States is shipped with an ultimate destination of Videocon in India for CRT manufacturing. These millions of pounds are often first shipped to Technologies Displays Mexicana (TDM) in Mexico for intermediate processing. The remaining minority of material is managed via other alternatives, e.g., there are one domestic and two Canadian lead smelters that historically accept material. In addition, Doe Run, a smelter in Missouri, is a viable option for only portions of the surrounding area's residuals. Xstrata (Glencore), the Canadian smelter across the border from Maine, has stopped accepting material from Maine and Maine currently sends their material to TDM. Various tile manufacturers are small-scale outlets for some material. While disposal and alternative daily cover (ADC) in landfills are legal outlets in some states with EPR programs, they often either do not count towards manufacturer goals or as recycling. Mono-fill "mineable" cells are being considered at disposal facilities as well. In some situations where manufacturer targets are too low and goals are met early, excess e-waste may flow to landfills.

How do regulators exercise oversight over CRT glass residual disposition?

While some states maintain a list of approved downstream facilities, others point to federal guidelines that reference R2 and e-stewards standards. Oversight varies state to state, but registration, fees, and annual inspections are typical. Some states sanction an open market where collection credits are traded and banked by manufacturers to fulfill their targets for up to three years.

Do regulators track numbers on residuals?

Most departments require annual reports of some form to track amounts of collected e-waste. These reports often do not track the specific quantity of residuals, but rather the direction residuals flow and not necessarily the ultimate disposition. Collection weights are tracked closer because that is the point at which manufacturer goals are measured and achieved. Estimates of residual amounts can be made using assumptions of 50 percent glass by weight and a split of 60 percent panel glass, 40 percent funnel glass. For example, Appendix Figure 1 shows Connecticut's trend of an increasing reliance on Videocon as an outlet to recycle residuals, while other options disappear over time. Other states follow a similar pattern of increased reliance on Videocon as an outlet.

State Specific Program Details

Connecticut⁴ - 2007

The Connecticut program includes a similar covered electronic device (CED) list as CA, but also includes desktop computers and printers. CEDs were banned from disposal effective January 1, 2011. Municipalities must submit a plan to provide convenient and accessible CED collections for their residents. OEMs must finance the transport and recycling of CEDs. OEMs pay the cost of processing recovered CEDs based on the OEM's recent market share of sales (also pay portion for orphans). Recyclers must maintain a written log that identifies responsible manufacturers by recording the brand and weight of each CED delivered. Recyclers submit bills to manufacturers for covered costs. Recyclers must also be approved by the state to get OEM funds and recycling payment rates are set by the department. Current approved Covered Electronic Recyclers include: ~~Creative Recycling Solutions~~ (removed 2/5/15), ECOvanta, Electronic Recyclers International, Metech Recycling, Newtech Recycling, RMG Enterprise, Take 2⁵. Whole CRT and glass residual shipment

³ <http://www.epa.gov/epawaste/consERVE/materials/recycling/certification.htm>

⁴ Oversight of Connecticut's E-Waste Recycling Law CGS 22a-629-640 conducted by Department of Energy and Environmental Protection (DEEP)

⁵ <http://www.ct.gov/deep/lib/deep/e-waste/approvedcers.pdf>

data analysis was provided by the Department of Energy and Environmental Protection, the government oversight agency (See Appendix Figure 1). Once glass is cleaned cullet and sorted it leaves Connecticut's legal purview.

Illinois⁶ - 2008

In Illinois, an annual registration fee is assessed to cover administrative costs. The annual registration fee tiers are based on the size of the operation and the participating party (e.g., around \$5,000 for OEMs and \$2,000 for recyclers). Additionally, OEMs must partner with recyclers to meet collection targets. In 2012, each OEM was required to recycle or reuse at least 40 percent of the total weight of the electronic devices that they sold in that category in Illinois during the calendar year beginning January 2, 2010. For program years 2013 and onward, the OEM target was increased to 50 percent of in-state sales volume from two years prior. Pending legislation, HB 1455, seeks to increase recycling targets from 50 percent to 80 percent.

The e-waste program does not track any numbers on the residuals and recyclers are not required to report any downstream vendor information to Illinois EPA. There are a couple of CRT glass residual management options located in Illinois. Com2 is testing the manufacturing of ceramic tile glaze frits in Carol Stream, IL with the intention of selling them to downstream tile manufacturers. In the interim, they are cleaning glass and shipping it downstream. Kuusakoski treats CRT glass residuals and uses as Alternative Daily Cover (ADC). Illinois and Vermont have decided collected pounds destined for ADC count towards OEM recycling goals, but they do not consider it to be recycling per se.

Indiana⁷ - 2009

The Indiana e-waste program is modeled after Minnesota law that passed two years prior, but Indiana's program is more inclusive of product categories and covered entities. OEMs must collect and recycle 60 percent by weight of previous year sales or face fees for every pound short of their goal. OEMs that use recyclers located in Indiana gain a 10 percent incentive and a 50 percent incentive for collections in a non-metropolitan county (60 percent if both). Material used as ADC does not count towards the OEM goal.

While OEMs and recyclers must register and report, the residuals are not tracked and facilities are not inspected. There is a disposal prohibition in place, but law explicitly states there are no consequences for violating it. Load check provisions don't exist. Indiana will be holding its first stakeholder meeting in June, 2015 to review and reassess the past six years of their program.

Maine⁸ - 2004

The state approves consolidators who pick up from collection sites; part of the approval includes approval of the processors/recyclers used by the consolidators. Most leaded CRT material is going to TDM in Mexico and onward to Videocon; some used to flow to the smelter Xstrata/Glencore in Canada, but they stopped accepting Maine's material en masse a few years ago. Unleaded panel glass that meets chemical characterization standards is approved for beneficial use in a paving product.

Michigan⁹ - 2008

The Michigan program focuses mostly on recyclers who act more as "consolidators" and don't cancel the device or even necessarily remove yokes. In the current market, they gather, weigh, stack and wrap, and ship materials primarily to TDM in Mexico and onward to Videocon. Recyclers used to crush units to save space, but then stopped when downstream didn't like it due to market specifications. When state inspectors visit recyclers, they confirm where the

⁶ Oversight of Public Act 97-0287 Electronic Products Recycling and Reuse Act by Illinois Environmental Protection Agency

⁷ Oversight of Indiana Code 13-20.5 by Indiana Department of Environmental Management (IDEM)

⁸ Oversight of Title 38 Statutes by Maine Department of Environmental Protection (DEP)

⁹ Oversight of Act 394 by Department of Environmental Quality (DEQ)

glass is going (primarily TDM). The recyclers report total weight of CEDs recycled during the previous year and identify all downstream shipments for further processing.

Minnesota¹⁰ – 2007

Minnesota considers the following uses of CRT panel class to be recycled: glass-to-glass recycling, ceramics, building blocks (glass), flat-panel displays, insulation (fiberglass), decorative tile, work surfaces (countertops), glass beads (reflective paint), costume jewelry, marbles. Recyclers can handle CRTs in one of three ways: ship CRT whole to downstream vendor, separate the glass components prior to shipment to downstream vendor, ship CRT whole to lead refining.

Registered stakeholders (OEMs and recyclers) buy and sell pounds of recycled CED credits before July 1. OEMs are obligated to recycle 80 percent by weight of video display device sales to households. If OEMs fall short of their volume obligations, they pay \$0.50/lb if <50 percent of obligation was met, \$0.40/lb for 50-90 percent of obligation met, \$0.30/lb for 90-100 percent of obligation met. OEMs can gain recycling credits up to 25 percent of their obligation if they over-recycle in a given year. These credits can be banked or sold to other OEMs and do not expire. Material used as ADC does not count towards OEM goals, thereby removing incentive for its practice.

E-waste recyclers must obtain and maintain liability insurance of \$1,000,000 coverage for environmental releases, accidents, and emergencies. They also must ensure all sites to which they ship e-waste and other wastes have equivalent coverage. Recyclers must ship 75 percent of waste generated each year and maintain three years of shipment records. As CRT glass value has transitioned from a net positive to a net negative, there are instances of warehouse abandonment or stockpiling for too long based on future market speculation or other issues. While Minnesota is not the only state to run into speculative accumulation issues, some have occurred.

In 2013, an analysis of end markets was conducted by Minnesota¹¹. In 2004, recyclers could earn \$205/ton for CRT glass, but are now paying \$200/ton to recycle it. Of recycler survey respondents, 61 percent dismantle all electronics on-site, 13 percent ship whole electronics to downstream, and 26 percent are some combination. Separated circuit boards are traded globally to secondary precious metal refineries based on their grade of gold (low is <100ppm Au, med is 100-400 ppm Au, High is >400ppm Au). Their report lists these downstream parties as: Umicore (Belgium), Boliden (Sweden), Aurubis (Germany), Xstrata Copper (Canada), Teck (Canada), Dowa (Japan). Japan exports have dwindled since 2012 (see appendix Figure 1 for similar California pattern).

Missouri – 2008

The Missouri e-waste program oversight is primarily based on the Resource Conservation and Recovery Act (RCRA) and recyclers are operating under the CRT exclusion. Their program is voluntary and not all in-state recyclers are signed up. There are no reporting requirements for participating recyclers. Missouri is home to Doe Run, the company that held the last operational primary lead smelter in the country. Having recently shut down their primary smelter, Doe Run is operating their secondary smelter at a 400-600 tons per day capacity, with one to five percent of the inputs being CRT glass. This equates to a “few tons a day” of CRT glass being processed. One of their primary furnaces shut down in the fall of 2014 due to plumbing issues and is anticipated to be running again in a few months and will start accepting material. This has left recyclers in the area to scramble to find other outlets. Recyclers in the area using Doe Run are

¹⁰ Oversight by Minnesota Pollution Control Agency (MPCA)

¹¹ <http://www.pca.state.mn.us/index.php/topics/preventing-waste-and-pollution/product-stewardship/initiatives-in-minnesota/electronics/minnesota-electronics-recycling-act/analysis-of-end-markets.html>

typically looking at 5 cents per pound transportation costs and 10 cents per pound charged at the door for an estimated cost of 15 cents per pound.

New Jersey – 2008

New Jersey is aligning their program similarly to Connecticut. They want to eliminate low annual targets and instead set rates to ensure funding for year-round collection.

New York¹² – 2010

There are no in-state processors in New York, so registered electronic waste collection locations identify their downstream destinations to the state, which are predominantly Sims and TDM. New York is home to NuLife, a facility that disassembled their furnace and imported it from England. They have acquired all of their permits from New York authorities and have an agreement in place for power rates drawing from the Niagara Falls dam infrastructure. Continued delays in setting up the operation have caused CRT accumulation issues. At one point, NuLife shipped large amounts of their accumulated material to a Pennsylvania warehouse. Recently, they have been shipping the material back from Pennsylvania in anticipation of firing up the furnace in summer 2015.

Oregon¹³ – 2007

Oregon instituted a disposal ban Jan 1, 2010 of computers, monitors, and televisions. Collection records must track and maintain documentation where outgoing CEDs are sold, shipped, or transferred.

Washington¹⁴ – 2006

The Department of Ecology's E-Cycle Washington program receives annual audit reports by independent auditors for review and approval. Early R2-based performance standards are used by these auditors. They are able to go to other states to confirm the practices, including Mexico's TDM and India's Videocon. While Washington does not have a CRT glass disposal ban, there is no disposal currently taking place under the E-Cycle Washington program. They would allow it if markets dictated it as the only viable option, but are not currently entertaining that notion.

Wisconsin¹⁵ – 2009

Wisconsin currently has 26 registered recyclers exercising a few CRT end market options. Of those 26, 22 recyclers send materials to CRT manufacturing, 14 send materials to tile manufacturers, 12 send materials to smelting, and 8 send materials to Dlubak/Closed Loop/Other. Novotec is an example of one of the few processors that works exclusively with smelters. There are only a few recyclers in-state that separate and clean the glass and after doing their initial processing, most other recyclers in-state send to these few with enhanced capabilities. Material collected beyond targets may be landfilled at a hazardous waste facility in Michigan or to solid waste facilities as ADC. However, all material as part of the program must be recycled.

Notable States without E-Waste Programs

Arkansas¹⁶

Arkansas has two grant programs that encourage the proper management of e-waste. Funded by tipping fees on disposal, their Computer and Electronic Waste Recycling Grants Program has annual awards of \$2,500,000. Another program called the E-waste Grants Program is funded by the sales of unneeded state-owned computers and distributes

¹² Oversight of Environmental Conservation Law Article 27 Title 26 by Department of Environmental Conservation

¹³ Oversight of ORS 459A.300-.365 by Oregon Department of Environmental Quality (DEQ)

¹⁴ Oversight of Chapter 70.95N by Department of Ecology (DoE)

¹⁵ Oversight of Statutes 287 by Department of Natural Resources (DNR)

¹⁶ Arkansas Department of Environmental Quality (ADEQ) grant program:
http://www.adeg.state.ar.us/poa/recycling/financial/ewaste_grants.aspx

about \$200,000 annually. A total of 2,919 tons of e-waste¹⁷ was reported as recycled during calendar year 2013 as a result of these grant programs. A majority of this material flows to Unicor (R2 certified) or Esco (e-Steward certified).

Kansas

Similar in structure to Arkansas, Kansas administered a grant program from 2009 to 2011. Funded by tipping fees, they cancelled the program when disposal dropped significantly. During the program, eight regional applicants shared \$500,000 for structural startup and were afforded \$150,000 each year for operational costs. The state's rural nature strains transportation costs.

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¹⁷ Arkansas State of Recycling Report:

https://www.adeg.state.ar.us/poa/recycling/resources/pdfs/report_state_of_recycling_2014.pdf

V. Appendix

Figure 1 – Connecticut Glass Destinations¹⁸

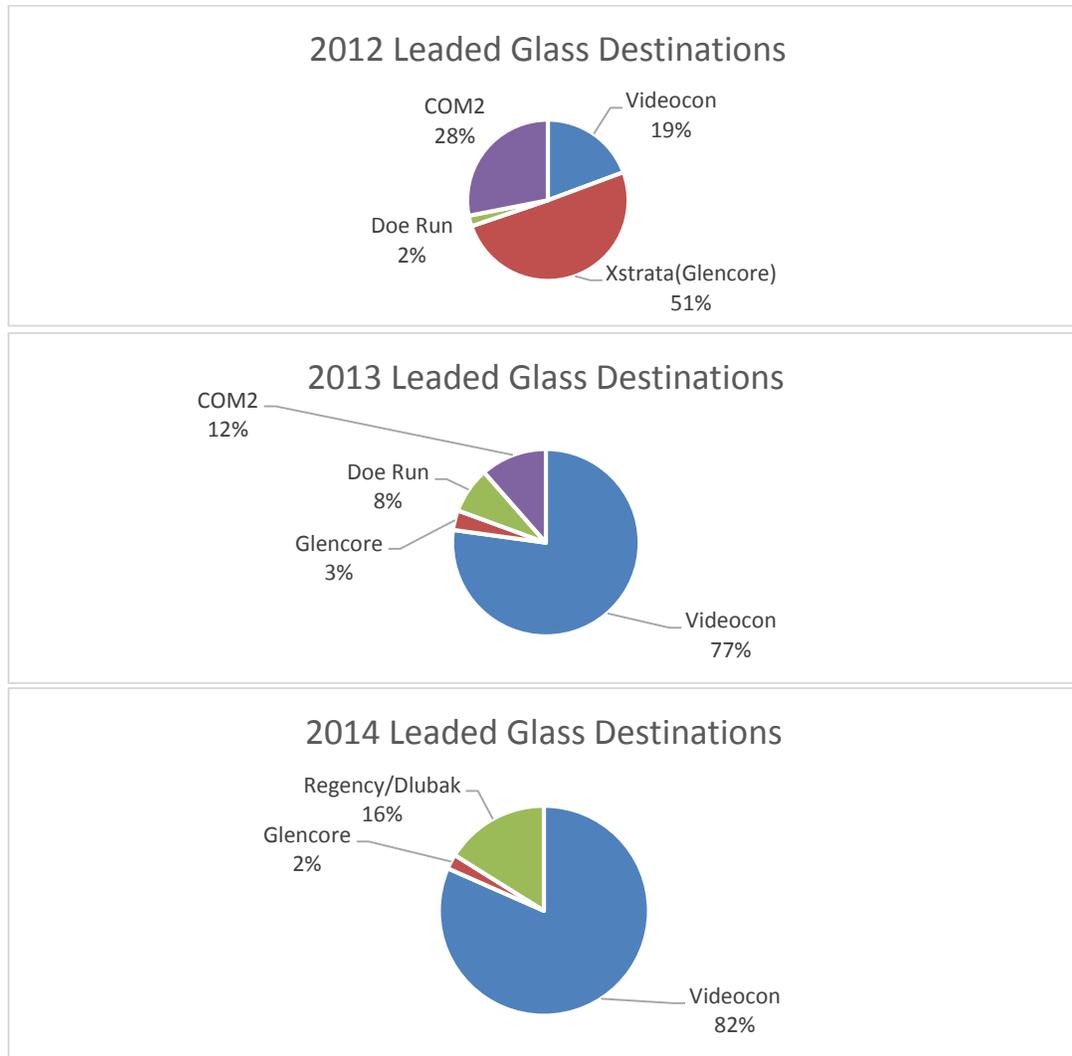
COM2 – proposed manufacturing ceramic tile glaze frits in Illinois

Doe Run – lead smelter in Missouri

Regency/Dlubak – glass processor in Ohio

Videocon – CRT glass manufacturer in India

Xstrata (Glencore) – lead smelter in Canada



¹⁸ Source: Correspondence with Connecticut DEEP. Assumes a split of 60 percent panel, 40 percent funnel glass in whole CRTs.

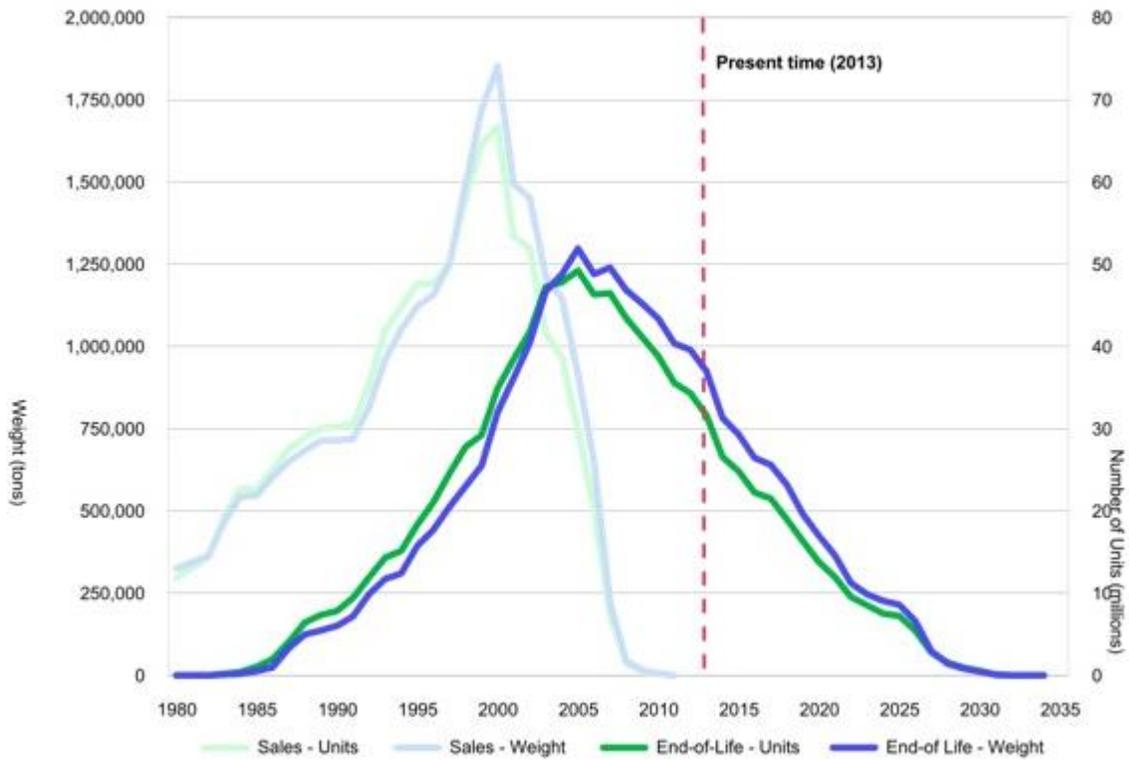
Figure 2 – E-Waste Collection Rates and Per Capita Data¹⁹

While the tables below are helpful for rough estimates, product scope and covered entities vary state to state. Some states would have higher numbers if universal waste collected was also counted.

State	Actual Pounds Collected 2012 or Jul11-Jun12	Lb/capita 2012 or Jul11-Jul12	Actual Pounds Collected 2013 or Jul12-Jun13	Lb/capita 2013 or Jul12-Jun13	Percent annual change
CA	214,907,700	5.65	203,495,000		
CT	11,471,953	3.20	13,230,587	3.39	+6% (projected)
HI	3,879,904	2.79	4,139,358		
IL	38,891,299	3.02	47,162,207		
IN	20,439,183	4.17	20,457,329		
ME	7,438,861	5.60	8,183,983		
MD					
MI	23,200,000	2.35	30,173,276		
MN	35,100,000	6.53	32,300,000	6.00	-8%
NC	42,834,960	4.39	35,763,400	3.67	-17%
NJ	48,100,000	5.43	38,600,000		
NY			99,500,000		
MO	1,986,411	0.33	3,329,360		
OR	26,670,441	6.84	27,727,768	7.11	+4%
OK	2,422,456	0.64	2,585,789		
PA	31,424,545	2.46	43,515,805		
RI					
SC	3,406,382	0.72			
TX	24,093,143	0.92			
UT	8,500,000	2.98			
VA	3,390,463	0.41			
VT	4,819,491	7.70	4,877,676	7.79	+1%
WA	43,473,438	6.30	45,180,945	6.55	+4%
WI	39,098,371	6.83	38,755,751	6.77	-1%
WV	2,877,519	1.55			

¹⁹ Source: Electronic Clearinghouse (<http://www.ecycleclearinghouse.org/content.aspx?pageid=59>)

Figure 3 – CRT Electronics Sales and Discard Data Forecast²⁰



²⁰ Source: U.S. EPA, Electronics Waste Management in the United States through 2009, May 2011.