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Governor

MICHAEL S. REGAN  
Secretary

## MEMORANDUM

TO: Environmental Review Commission  
The Honorable Jimmy Dixon, Co-Chairman  
The Honorable Chuck McGrady, Co-Chairman  
The Honorable Trudy Wade, Co-Chairman

FROM: Anderson Miller, Director of Legislative Affairs, NCDEQ

SUBJECT: Study of Electronics Recycling in North Carolina

Pursuant to G.S. 130A-309.140, *“The Department shall submit a report on the recycling of discarded computer equipment and televisions in the State under this Part to the Environmental Review Commission. The report must include an evaluation of the recycling rates in the State for discarded computer equipment and televisions, a discussion of compliance and enforcement related to the requirements of this Part, and any recommendations for any changes to the system of collection and recycling of discarded computer equipment, televisions, or other electronic devices.”*

DATE: May 12th, 2017

If you have any questions or need additional information, please contact Anderson Miller by phone at 919-817-0817 or via email at [Anderson.Miller@ncdenr.gov](mailto:Anderson.Miller@ncdenr.gov).

cc: Secretary for the Environment Sheila Holman, NCDEQ  
Division of Waste Management Director Michael Scott, NCDEQ

**Study of Electronics Recycling in North Carolina**  
**North Carolina Department of Environmental Quality**  
**April 1, 2016**

**Introduction**

This study fulfills the requirements of Session Law 2015-286. It presents an analysis of the status and performance of the North Carolina legislated system to collect and recycle televisions, computer equipment, and other electronics and provides recommendations on how to improve that performance.

North Carolina has established a robust electronics recycling collection system that gives its citizens the opportunity to recycle practically every piece of electronic equipment they purchase and use. This collection system diverts more than 19,000 tons of electronic equipment from landfills each year, delivering those materials to a largely in-state primary processing infrastructure that then distributes the products and commodities into a larger, global marketplace. In total, local government and manufacturer programs have diverted almost 90,000 tons of electronics from disposal since Fiscal Year 2009-10.

As enacted under Session Law 2010-67 (Senate Bill 887), the electronics recycling system in North Carolina was established under principles found in the opening clauses of the bill:

- (1) The computer equipment and television waste stream is growing rapidly in volume and complexity and can introduce toxic materials into solid waste landfills.
- (2) It is in the best interest of the citizens of this State to have convenient, simple, and free access to recycling services for discarded computer equipment and televisions.
- (3) Collection programs operated by manufacturers and local government and nonprofit agencies are an efficient way to divert discarded computer equipment and televisions from disposal and to provide recycling services to all citizens of this State.
- (4) The development of local and nonprofit collection programs is hindered by the high costs of recycling and transporting discarded computer equipment and televisions.
- (5) No comprehensive system currently exists, provided either by electronics manufacturers, retailers, or others, to adequately serve all citizens of the State and to divert large quantities of discarded computer equipment and televisions from disposal.
- (6) Manufacturer responsibility is an effective way to ensure that manufacturers of computer equipment and televisions take part in a solution to the electronic waste problem.
- (7) The recycling of certain discarded computer equipment and televisions recovers valuable materials for reuse and will create jobs and expand the tax base of the State.
- (8) While some computers and computer monitors can be refurbished and reused and other consumer electronics products contain valuable materials, some older and bulkier consumer electronic products, including some televisions, may not contain any valuable products but should nevertheless be recycled to prevent the release of toxic substance to the environment.

With the implementation of the legislation, electronics recycling now delivers a range of significant benefits to North Carolina, including:

- The return of energy efficient commodities and products to the general economy.
- Reduction in long-term dependence on solid waste landfills, protecting the state's existing disposal capacity.
- Diversion of hazardous materials, such as lead and mercury, from solid waste landfills.

- Growth of the state’s recycling economy, which includes major electronics processors that have made substantial investments in plant, equipment, and job creation.
- Meeting citizen demand for alternatives to disposal for the products they use.

Senate Bill 887 was produced as a result of a stakeholder process aimed at achieving a balance of responsibilities among those stakeholders within an overall structure of producer responsibility. Producer responsibility reduces the dependence of recycling systems on taxes and fees and places system costs more within the chain of actual product manufacturing and consumption. Commodity market conditions have begun to negatively affect the balance of the electronics producer responsibility program in North Carolina, and in particular in regard to the costs of television recycling.

North Carolinians continue to steadily purchase televisions and other electronics. Although these items are durable products, they will predictably reach the end of their useful life and will need to be managed as discards, replaced by new products that will in turn need to be eventually managed as discards in a continual cycle. Because North Carolina has now established a universal collection system for these products, it has ensured that future discarded electronics will be recycled instead of disposed in landfills.

There are costs associated with this collection system in the establishment and service of drop-off sites, and the retrieval, consolidation, and transport of materials to market. Because of recent changes in economic conditions, there are also market costs imposed on collection programs by processors of electronic equipment. Although the commodities embedded in electronics are in consistent demand for a range of industrial uses worldwide, many electronics have a negative market value at the stage of initial processing, which is also true for other kinds of widely recycled products such as tires. The negative market values result principally from the complex processing of the products to extract commodities and the competing value of virgin commodities in the marketplace, all within the general context of global industrial production and basic supply and demand.

The intention of North Carolina’s electronics recycling legislation was to create recycling opportunities for citizens largely through the existing infrastructure and capabilities of local recycling programs, allowing citizens to use services that are reliable, convenient, and with which they are highly familiar. The law has overwhelmingly succeeded in accomplishing this goal. The intent was also to support the costs of those local governments programs through producer responsibility obligations. This study finds that producer support is inadequate to the needs of the system, especially in response to negative fluctuations in market conditions. As a result, local governments are directly bearing a higher level of electronics recycling costs, as documented in this study.

The recommendations in the study seek to address this cost balance situation by strengthening the producer responsibility functions of the law and reducing the cost burden on local governments. In addressing the producer responsibility components of the law, North Carolina can sustain a system that serves as a precedent for other, emerging durable products such as solar panels when they reach the end of their useful life.

Session Law 2015-286 directs the Department of Environmental Quality (DEQ) to address a number of specific issues in this study:

- The changing waste stream, including the transition from televisions containing cathode ray tubes to flat screen televisions.
- The current status of North Carolina's recycling system, including cost and financing issues, and options that may be available to reduce costs and establish sufficient funding to cover necessary costs
- Opportunities for more efficient and effective recycling systems
- Any other issue the Department deems relevant

The structure of this study follows these points in sequence in four main Sections, with additional information and recommendations included in the study's Conclusion.

## **Report Section 1: The Changing Electronics Waste Stream**

### Generation of TVs and Electronics

Discarded TVs and other electronics will be generated at steady rates in North Carolina for the foreseeable future. Sales data indicates that consumers continue to purchase and use a rising number and variety of devices, constantly replacing older technologies with newer equipment. Electronics are more durable than immediate consumable discards such as plastic bottles or aluminum cans, and predicting when they will be generated at the end of their useful life is difficult. However, it is clear that electronics turn over frequently in households, guaranteeing a consistent discard flow in North Carolina.

As consumer appetite for electronic equipment grows, so will the challenge of managing those products as discards. As a sign of the robust consumption of electronics products, a July 2014 report from the Consumer Technology Association (CTA) projected revenues of consumer electronics to reach a record high of \$211.3 billion in 2014.<sup>1</sup> A subsequent 2015 CTA report indicated continual growth across the technology sector, especially as new and different types of electronics emerge in the market place.<sup>2</sup>

The track record of electronics sales signals a predictable but complex and frequently changing flow of electronics discards. Fortunately, electronics recyclers in North Carolina demonstrate agility in reacting to the shifting discard stream and are capable of handling a very wide range of products. This flexibility in the processing infrastructure helps ensure that local programs can also adapt in the collection of new types of electronic discards, such as flat panel televisions and tablets.

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<sup>1</sup> "Consumer Electronics Industry Revenues to Reach All-Time High in 2014, Projects CEA's Semi-Annual Sales and Forecasts Report" - <https://www.cta.tech/News/News-Releases/Press-Releases/2014/Consumer-Electronics-Industry-Revenues-to-Reach-All.aspx> "Driven in part by the skyrocketing sales of connected devices, revenues for the consumer electronics (CE) industry are projected to grow two percent in 2014, reaching a record high of \$211.3 billion, according to U.S. *Consumer Electronics Sales and Forecasts 2010-2015*, the semi-annual industry report released today by the Consumer Electronics Association (CEA)."

<sup>2</sup> "New Tech to Drive CE Industry Growth in 2015 – Projects CEA's Midyear Sales and Forecast Report Consumer" - <https://www.cta.tech/News/News-Releases/Press-Releases/2015-Press-Releases/New-Tech-to-Drive-CE-Industry-Growth-in-2015,-Proj.aspx> "Demand for emerging technology is redefining the consumer electronics (CE) landscape. According to the U.S. *Consumer Electronics Sales and Forecasts*, the semi-annual industry report released today by the Consumer Electronics Association (CEA), retail revenues for the consumer electronics (CE) industry are now projected to grow 2.4 percent in 2015 to reach \$285 billion, led by 101 percent year-over-year growth in emerging product categories

### Projection of Electronics Management Using State Report Data

There is no available data documenting the rate of electronics generation specifically for North Carolina. However, national data, extrapolated for North Carolina, can offer insights into in-state generation. The track record of increasingly mature local government collection programs is also a good indicator of what those programs can expect to handle in coming years.

The following table shares electronics collection trends for the last three fiscal years in North Carolina, which cover a period in which a mature system was established and operational. The sources of the data in the table are statutory local government and manufacturer reports to the NC DEQ. This data shows growth in television collection and a slight decline in computer and other electronics collection.

#### Total Electronics Recycling in North Carolina, Fiscal Year 2012-13 to 2014-15

Overall Recycling of Electronics	FY2012-13	FY2013-14	FY2014-15	Three Year Average
Manufacturer television collections	1,623.54	2,460.26	2,834.12	2,305.97
Manufacturer computer equipment collections	2,098.88	1,843.43	1,193.37	1,711.89
Local Government televisions	8,739.47	9,314.94	10,025.66	9,360.02
Local Government other electronics	5,419.81	5,470.99	5,050.77	5,313.86
Total Tons	17,881.70	19,089.62	19,103.92	18,691.75

The trends in the table will be affected by major changes in electronics sales, particularly in regard to televisions and computer monitors. To date, CRT televisions have been the dominant products collected in North Carolina local government recycling programs. CRTs are relatively heavy, weighing on average twice as much as the Flat Panel Display (FPD) televisions that now completely dominate consumer buying. Purchase and use of CRT televisions dropped dramatically through the early 2000s, with a virtual end to CRT sales in 2010 which effectively caps the future discard flow of these products. With the rapid rise in the sale of flat panel televisions through the 2000's, it is clear they will become the prominent discard over time, thus reducing TV weight on a unit basis. Countervailing that possible trend is evidence that flat panel televisions will have shorter use lives than CRTs and may be discarded more quickly. There are already signs, as discussed in the data below, that FPDs are growing as a percentage of TVs collected for recycling in local programs.

Converting the tonnage in the table above to a unit basis and then pairing that with sales data below can provide additional insight into future generation. Since FY 2009-10, combined local government and manufacturer recycling activity has diverted a total of 50,769 tons of televisions from disposal, almost exclusively CRTs. This tonnage is the equivalent of removing 1.75 million CRT televisions from North Carolina households since the sale of CRTs effectively ended in 2010. Combined manufacturer and local government programs recovered an annual average of 402,276 televisions over the last three fiscal years with a slight trend upward in recovery. TV tonnage for FY 2014-15 is estimated to be equivalent to 443,440 televisions.

### Household Television Use in North Carolina

Data estimating the number of televisions owned by households offers additional perspective into future television discards in North Carolina. Using four different studies that placed TV ownership

between 2.42 and 3.1 sets per household, data is extrapolated and averaged for North Carolina in the table below.<sup>3</sup>

Total Household Television Ownership in North Carolina – 2005, 2010, and 2015

	2005	2010	2015
Number of NC Households	3,298,742	3,715,565	3,971,235
Number of TVs in NC Households	9,229,098	10,683,226	11,497,770

Televisions are durable products with life spans of ten years or more. In theory, a portion of the 9.2 million televisions owned by North Carolina households in 2005 would be emerging into collection programs ten years later in 2015. Comparing the estimated collection of 443,440 televisions in 2014-15 to 2005 estimated household ownership, it appears recovery programs are annually handling about 5 percent of owned TVs from a decade previous. This speaks to the rolling nature of television generation and leads to questions about the balance between CRTs and Flat Panel televisions in both ownership and in discards.

This study used two main methods and data sources to estimate the balance of CRTs and FPDs now present in households that will eventually be ready for end-of-life management. For purposes of this study, ownership data was modeled on an assumed annual transition rate in CRT to FPD ownership of 4 percent per year. The data from this model is included in the table below, which also shows a projection of CRT TV ownership based on a randomized survey of households by the Consumer Technology Association in the U.S. for both 2014 and 2015.

Estimates of Household CRT and FPD TV Ownership in North Carolina – 2005, 2010, and 2015

	2005	2010	2015
Total TV Ownership, with FPD/CRT breakout below based on 4% annual transition	9,229,098	10,683,226	11,497,770
CRT Portion	8,121,606 (88%)	7,264,594 (68%)	5,518,929 (48%)
FPD Portion	1,107,492 (12%)	3,418,632 (32%)	5,978,840 (52%)
CRT ownership using Consumer Technology Association survey data	NA	NA	2,672,414
Net FPD ownership from CTA survey data	NA	NA	8,825,356

In the upper estimate of this table, based on the 4 percent transition model, the active ownership of CRT televisions by North Carolina households dropped by 1.75 million sets between 2010 and 2015, which is

<sup>3</sup> The four sources of data are: 1) State of Florida Electronics Residential Survey 2003 Report, [http://www.dep.state.fl.us/waste/quick\\_topics/publications/shw/electronics/FloridaElectronicsResidentialSurvey2003ReportCorrected.pdf](http://www.dep.state.fl.us/waste/quick_topics/publications/shw/electronics/FloridaElectronicsResidentialSurvey2003ReportCorrected.pdf), 2) Consumer Electronics Association, "2005 CE Ownership and Market Potential" study, <http://www.businesswire.com/news/home/20050517005989/en/Household-Penetration-CE-Products-Soars-2005-Ownership>, 3) U.S. EPA, "Electronics Waste Management in the United States Through 2009," May 2011 <http://www.allelectronicsrecycling.com/electronic-waste-management-in-the-United-States-through-2009.pdf>, and 4) Nakono, TV Sets: Average Number of TV Sets per TV Household (interpolated from 2009 Nielsen study) <http://www.nakono.com/tekcarta/databank/full/33/>

exactly in line with the estimate of TVs recovered in North Carolina in the same time period. However, the Consumer Technology Association estimate extrapolated for North Carolina points to a much smaller number of CRTs left in NC homes in 2015. If a 5 percent transition rate between FPDs and CRTs is assumed in the model instead of 4 percent, which may be more in line with FDP sales data (see below), North Carolina household ownership of CRTs in 2015 would be 4.02 million, edging closer to the CTA estimate. That would mean CRT ownership dropped 2.39 million between 2010 and 2015, 37 percent higher than the 1.75 million tons of televisions counted as recovered in that time period. The gap may be explained by some CRT TVs going to other channels not accounted for in the recovery data (e.g., thrift stores and TV repair shops) and possibly some incidental disposal.

Flat Panel sales trends provide insight into the balance of FPDs and CRTs in North Carolina households. One published source has estimated total national sales of FPD televisions between 2001 and 2014 at 174 million. Extrapolating for North Carolina, 5.39 million FPDs were purchased by in-state households between 2001 and 2014. Using CTA-provided sales data from the table below, an additional 2.4 million FPDs may have been purchased by North Carolina households in 2014 and 2015, pushing total FPD ownership to 7.8 million sets by the end of 2015, about 31 percent higher than the 5.98 million sets in the upper, modeled estimate above. The CTA sales data confirms the steady ongoing increase in FPD television ownership in North Carolina.

National Television Sales, 2012 – 2016, Extrapolated for North Carolina

	National Television Unit Sales	Extrapolation for NC
2012	40,310,000	1,249,610
2013	39,191,000	1,214,921
2014	37,587,000	1,165,197
2015 (estimated)	40,192,000	1,245,952
Subtotal through 2015	157,280,000	4,875,680
2016 (projected)	39,922,000	1,237,582
TOTAL	197,202,000	6,113,262

An estimated total of 4.86 million FPDs were brought in to North Carolina households between 2012 and 2015. The strong sales trend of FPDs starting in 2001 and accelerating to a high pace by 2012 would have already added a large number of FPDs to North Carolina ownership before 2012. The 5.98 million FPD estimate in the table above therefore seems to undercount FPD ownership and, by extension, overcount the number of CRTs left in NC households.

Given this analysis and the contributing data, the table below provides a final estimate of FPD and CRT ownership in North Carolina in 2015. With evidence that purchasing is strongly pushing more FPD TVs into North Carolina households, giving more credence to use of the CTA national survey data, the table simply splits the difference between the modeled estimate and the CTA extrapolated estimate. The resulting figures actually correspond closely with an estimate of the FPD/CRT balance if a 5% annual transition rate between the technologies is assumed in the model above.

Estimate of the Status of 2015 Household TV Ownership and Associated Weights in North Carolina

	2015 (number of units)	Estimated Weight	
		Tons	Pounds
Total Television Ownership	11,497,770		

FPD Portion	7,402,098	92,526	185,052,450
CRT Portion	4,095,672	118,774	237,548,952

### Computer Equipment Generation

As with televisions, the experience of local government and manufacturer programs in collecting computer equipment provides insight into the future generation of discarded products. These combined efforts have recovered 38,824 tons of computer equipment and other electronics since the inception of the state’s electronics recycling law.<sup>4</sup> Annual local government collection of computer equipment and other non-television electronics has declined slightly since Fiscal Year 2011-12, but not as dramatically as manufacturer computer collections, which have dropped 70 percent in the same period. Local government “Other Electronics” tonnage has dropped as a percentage of total local government collections from 44 percent in Fiscal Year 2011-12 to 34 percent in Fiscal Year 2014-15 (“Other Electronics” is a category used in the statutory Local Government Solid Waste and Materials Management Annual Report form to distinguish these materials from televisions).

### Local Government and Manufacturer Collection of Computer Equipment and Other Electronics

	FY2010-11	FY2011-12	FY2012-13	FY2013-14	FY2014-15	TOTAL
Manufacturer Computer Equipment Collections	2,895.82	3,996.03	2,098.88	1,843.43	1,193.37	12,027.53
Local Government Other Electronics Collections	4,432.15	6,423.58	5,419.81	5,470.99	5,050.77	26,797.30
Total Computer and Other Electronics totals by year	7,327.97	10,419.61	7,518.69	7,314.42	6,244.14	38,824.83

The decline in overall computer and other electronics tonnage since Fiscal Year 2011-12 may reflect a faster household turnover of flat panel display monitors and a quicker discard of the outmoded CRT monitors than has been true for televisions. In a 2011 report, EPA estimated the average lifespan for common electronic equipment, as outlined in the table below, plus the two main kinds of televisions.<sup>5</sup> Note that a CRT television was projected by EPA to have a use lifespan 4.5 years longer than a CRT monitor.

### Projected Lifespan of Computers and Displays

Product	Estimated Use Lifespan (in years)
Desktop computer	12.25

<sup>4</sup> Statutory annual local government reports use “other electronics” to designate all non-television collected tonnage. The vast majority of “other electronics” remains computer equipment, defined in the electronics legislations as “Any computer, monitor or video display unit for a computer system, and the peripheral equipment except keyboards and mice, and a printing device such as a printer, a scanner, a combination print-scanner-fax machine.”

<sup>5</sup> “Electronics Waste Management in the United States Through 2009,” U.S. EPA, May 2011, EPA 530-R-11-002 <http://www.allelectronicsrecycling.com/electronic-waste-management-in-the-United-States-through-2009.pdf>



Laptop (portable) computer	5.9
CRT Monitors	9
Flat Panel Display Monitors	9
CRT Televisions	13.5
Flat Panel Televisions	9

A 2013 MIT study estimated residential generation of computer equipment materials nationwide for the year 2010.<sup>6</sup> Although the information is somewhat dated, it is useful in analyzing annual generation of the main categories of computer equipment. The table below shows the MIT data extrapolated by population percentage to North Carolina for the year 2010. The 12,260 tons of discarded computer equipment corresponds within 15 percent of the 10,420 tons of computer and other electronics handled by local government and manufacturer programs in North Carolina in FY11-12.

Estimates of Residential Generation of Computer Equipment in 2010

	National Units	National Tons	NC Tons Share
Desktops	14,385,000	158,235	4,905
Laptops	3,728,000	11,930	370
CRT Monitors	7,485,000	188,996	5,859
Flat Panel Monitors	2,953,000	36,322	1,126
TOTALS	28,551,000	395,483	12,260

Extrapolation from the MIT data finds that North Carolina households discarded 5,859 tons of CRT monitors in 2010, the same year that CRT monitor sales dwindled down effectively to zero. With a lifespan of nine years, the years between 2010 and 2015 would have seen a steady decline in household ownership of CRT monitors. The Consumer Technology Association included a question on CRT monitor ownership in its 2014 and 2015 surveys.<sup>7</sup> In 2015, only 20 percent of U.S. households reported having a CRT monitor. Extrapolating this figure for North Carolina, an estimated 794,427 CRT monitors were still in the state's 3,971,235 households in 2015. The CTA study further estimated total national household CRT monitor weight to be about a billion pounds; extrapolated for North Carolina, the figure would be 31 million pounds, or 15,500 tons.

While CRT monitor use has declined, household purchase and use of lighter flat panel monitors has increased. Between 2001 and 2014, U.S. households purchased almost 109 million flat panel monitors, extrapolating to a total North Carolina household share of 3.38 million. CTA data projected for North Carolina shows that household purchasing may have added 389,000 flat panel monitors in the two years 2014 and 2015. Assuming 15 percent of the monitors bought between 2001 and 2014 have been discarded and then adding the units purchased 2014 and 2015 produces an estimate of approximately 3.25 million flat panel monitors currently in North Carolina homes.

<sup>6</sup> "Quantitative Characterization of Domestic and Transboundary Flows of Used Electronics - Analysis of Generation, Collection, and Export in the United States," Huabo Duan, T. Reed Miller, Jeremy Gregory, and Randolph Kirchain Massachusetts Institute of Technology, December 2013.

<sup>7</sup> The report described herein was designed and formulated by the Consumer Electronics Association (CEA). It represents the findings of a quantitative study administered via telephone interview between June 18 and 21, 2015 to two national probability samples, which, when combined, consists of 1,009 U.S. adults. 509 interviews were conducted by landline phone, and 500 interviews were conducted by cell phone.

Combining the CRT estimate above to flat panel monitor figure generates an overall estimate of 4.04 million computer displays currently owned by North Carolina households, which is just slightly above one per home. A U.S. Census report estimated that 88.4 percent of all households owned a computer in 2013.<sup>8</sup> Assuming that all of the computers were paired with a monitor and that some of the 88.4 percent of all households owned more than one computer and monitor, an ownership ratio of one monitor per household seems reasonable.

Using the data above, it can be calculated that flat panel monitors outnumber CRT monitors currently in North Carolina households by about 4 to 1. Overall purchase of monitors, however, seems to be declining. The 3.38 million flat panel monitors extrapolated as purchased by North Carolina households between 2001 and 2014 translates into annual rate of about 260,000 monitors per year. However, an average would be misleading in that LCD monitor purchase would have grown from small number in 2001 to a figure probably well over 260,000 per year a decade later. Information from the 2011 EPA study would project North Carolina household purchase of flat panel monitors to be 315,000 that year (meaning that roughly 1 in 10 NC households bought a flat panel monitor in 2011). However, CTA sales data for 2012 through 2016 shows that there has been a continual decline in residential flat panel monitor purchases from that higher peak a few years previous.

Flat Panel Monitor Sales, 2012 – 2016, Extrapolated for North Carolina

	National Unit Sales	North Carolina Share
2012	8,115,000	251,565
2013	7,344,000	227,664
2014	6,610,000	204,910
2015 (estimated)	5,949,000	184,419
2016 (projected)	5,354,000	165,974

The relatively quick decline in heavier CRT monitor discards and the evident decline of overall monitor purchases means that the weight of computer display devices local government collection programs can expect to handle will also drop over time. The same is also likely true for computers. Market share sales of desktop computers, which outweigh laptop or notebook computers by as much as 3 to 1 on a unit basis, peaked in 2008. Laptop/notebooks have become the dominant kind of purchased computer since that time, but in the last few years, tablet computers, which weigh much less than desktops and generally less than laptops, have captured as much as a quarter of the market.<sup>9</sup> In general, this means that the kinds of computer devices emerging from households into local government collection programs will change over the next decade and, in general, become substantially lighter.<sup>10</sup>

#### Summary of Trends in Display Technologies

Certain basic trends in local government collection programs seem to be supported by sales data for TVs, monitors, and other electronics. The television fraction of local collections has risen relative to

<sup>8</sup> <https://www.census.gov/history/pdf/2013comp-internet.pdf>

<sup>9</sup> According to the CTA Report “Digital America 2014,” tablets were projected to already achieve a household penetration rate of 58 percent by 2016 – see: [http://content.ce.org/PDF/2014DigitalAmerica\\_abridged.pdf](http://content.ce.org/PDF/2014DigitalAmerica_abridged.pdf)

<sup>10</sup> Statista – “Share of selected types of computers on all PC sales from 2008 to 2015 in the U.S.” <http://www.statista.com/statistics/269173/pc-sales-by-computer-type-from-2008-to-2015-in-the-us/>

other electronics, reflecting a slower household turnover of CRT televisions than CRT monitors and a general lightening of computer discards over time. This trend can be expected to continue.

For televisions in particular, FPDs are now clearly the majority of televisions owned by North Carolina households and they are lighter than CRTs. However, FPDs are also projected to not last as long as CRTs and will be discarded at a faster rate.

Still, it can be expected that general TV tonnage will flatten and decline slightly over time. If FPDs weigh on average less than half of what CRTs weigh, then FPDs would need to be generated at twice the rate for overall TV tonnage to stay steady, all other factors remaining equal. But FPDs have estimated life use spans of roughly two thirds of CRTs, as indicated in EPA’s 2011 report. This translates into a mathematical light-weighting effect in local government television tonnage. The general projected decline in tonnage will help moderate the financial impact of televisions in the system, in part also because FPDs are cheaper to process than CRTs.

**Report Section 2: Current Status of North Carolina's Electronics Recycling System**

Computer and Television Manufacturer Activities

A central aspect of North Carolina’s electronics law is the active participation by computer and television manufacturers in supporting the system under obligations detailed in the legislation. Both computer and TV manufacturers must register with the state annually, pay a fee associated with that registration, and then each are subject to different kinds of recycling requirements. The base registration rate for computer manufacturers is \$15,000 per year but they are also given a choice to register at alternative levels and pay a different fee depending on their implementation of infrastructure to recycle electronics (in addition, all computer manufacturers must provide a free take-back mechanism to household consumers, such as mail back services for old equipment). The table below shows the three levels of registration for computer registration. Note that the figures are annual renewal amounts; a manufacturer registering for the first time pays \$15,000 at Level I, and \$10,000 for Levels II and III.

Computer Manufacturer Registration Levels

Level	Annual Registration Renewal Amount	Requirement for Registration Level
Level I	\$15,000	Must provide at least one or more of the following to take back computer equipment made by the manufacturer: <ul style="list-style-type: none"> <li>• Mailback option</li> <li>• A physical collection point</li> <li>• An annual collection event</li> </ul>
Level II	\$7,500	In addition to the take back requirements above: <ul style="list-style-type: none"> <li>• Maintain a physical collection site open during normal business hours for computer equipment in the 10 most populous municipalities in North Carolina</li> </ul>
Level III	\$2,500	In addition to the requirements under Levels I and II: <ul style="list-style-type: none"> <li>• Maintain a physical collection site in 50 of the State's counties, of which 10 of those counties shall be the most populated counties in the State</li> </ul>

An assumption built into North Carolina’s electronics recycling law is that by giving computer manufacturers options for participation in the system at lower fees, their efforts will divert a substantial amount of material through the collection sites they establish, thus reducing some of the management burden on local governments. This is important because the direct financial support that the state provides to local governments for running electronics programs comes primarily from computer manufacturer registration fees. To shed light on how this balance of management duties is working, the table below shows the trends in computer manufacturer registration on Level II and Level III and the related tonnage reported by the manufacturers at their designated sites. Note that there have been no Level III registrants to date but the number of Level II registrants has been rising over time, doubling between FY 2013-14 and FY 2014-15 to an historical high of 32 Level II registrants.

**Computer Manufacturer Level II and Level III Registration and Recovery**

Fiscal Year	Number of Companies Registering at Level II	Number of Companies Registering at Level III	Number of Collection Sites Established by Level II Companies	Number of Collection Sites Established by Level III Companies	Tonnage of Material Collected at Level II and Level III Collection Sites
FY 2010-11	0	0	0	0	0
FY 2011-12	6	0	11	0	38.35
FY 2012-13	10	0	28	0	27.70
FY 2013-14	16	0	32	0	68.81
FY 2014-15	32	0	26	0	45.32
TOTAL					180.18

The following table shows the performance of manufacturer take back programs in managing end-of-life computer equipment. The data in the table is from reports provided by manufacturers directly to DEQ.

**Computer Equipment Recovery by Manufacturer Take-back Programs**

Fiscal Year	Number of Companies with Take-back Programs	Number Companies with Take-back Programs Reporting Zero Collections	Total Tonnage of Material Collected Through Manufacturer Take-back Programs
FY 2010-11	11	3	29.6
FY 2011-12	21	14	5.07
FY 2012-13	13	5	3.77
FY 2013-14	20	10	5.42
FY 2014-15	23	12	4.94
TOTAL			48.8

The data in the tables above can be used to compare the performance of the Level II and manufacturer take-back programs with the performance of local government programs since the inception of the law. As mentioned above, in local government solid waste annual reports, local governments provide two basic categories of data to DEQ: Televisions and Other Electronics. The Department’s survey of local government recycling programs discussed in Section 3 of this report allows DEQ to calculate the computer equipment portion of “other electronics,” thus allowing local government recovery of the materials to be compared with manufacturer-recovered tonnage. As can be seen in the table below,

local government recycling programs are handling more than 98 percent of computer equipment in the state.

Comparison of Level II, Mailback, and Local Government Recovery of Computer Equipment (in tons)

Fiscal Year	Manufacturer Collection Programs		Local Government Collection of Computer Equipment	Percentage of Total Computer Equipment Recovery by Local Governments
	Manufacturer Take Back	Manufacturer Level II Recovery		
FY 2010-11	29.6	0	2,269.26	99%
FY 2011-12	5.07	38.35	3,288.87	99%
FY 2012 -13	3.77	27.70	2,774.94	99%
FY 2013-14	5.42	68.81	2,801.15	97%
FY 2014-15	4.94	45.32	2,585.99	98%
TOTAL	48.8	180.18	13,720.22	98%

With the overwhelming balance of computer equipment being managed in North Carolina by local government electronics recycling programs, the cost burden also then overwhelmingly belongs to those programs. This burden is partially supported by distributions to eligible local governments from the state Electronics Management Fund, which receives the bulk of its revenues from computer manufacturer registrations. It can be calculated that the Electronics Management Fund would have received an additional \$240,000 in FY 2014-15 for local government distributions if all computer manufacturers had registered at Level I. An alternate way to look at this is to consider that Electronics Management Fund effectively paid \$0.67 per pound for the recovery of the 180.18 tons of computer equipment recovered by Manufacturer Level II sites in FY 2014-15. In comparison, and as shown in Section 3 of this report, local government survey data reveals that these same tons of computer equipment could have been managed by local government programs for as little as \$0.08 per pound.

Television Manufacturer Registration and Recycling Activities

The number of registering television manufacturers has been relatively steady since the inception of the electronics recycling law. TV registration revenues are largely used to support the administration of the program by DEQ, as funded by the Electronics Management Fund.

Television Manufacturer Registrations, Fiscal Year 2010-11 to Fiscal Year 2015-16

	FY 2010-11	FY 2011-12	FY 2012-13	FY 2013-14	FY 2014-15	FY 2015-16
# of Registrants	30	36	35	33	31	27
Fee Total	\$75,000.00	\$90,000.00	\$87,500.00	\$82,500.00	\$77,500.00	\$67,500.00

As detailed in the legislation, television manufacturers must annually recycle or arrange for the recycling of their market share of televisions that are collected in North Carolina. To measure their compliance with the legislation, television manufacturers must report annually on the total weight of televisions the manufacturer collected and recycled in the State during the previous fiscal year. Manufacturer reports are then analyzed and reconciled with local government data, allowing DEQ to get an accurate count of the total amount of TVs recycled by both manufacturer non-government source collection and by local government operated programs.

TV manufacturers effectively secure their share of recycled televisions by giving recovery “quota” to electronics recyclers who in turn source television tonnage in North Carolina for recycling. Ideally, since the vast majority of televisions are collected by local government programs, there should be a great deal of overlap between recyclers receiving manufacturer quota and those recyclers who serve local programs. However, data from manufacturer recycling reports, local government annual solid waste reports, and local government information required for annual state distributions shows a significant gap between which recyclers TV manufacturers use to meet their obligations and which recyclers community programs use to pick up electronic material.

For Fiscal Year 2014-15, television manufacturer reports to DEQ documented the use of just four recycling companies to manage manufacturer tonnage obligations in North Carolina. The total tonnage collected by those four companies from local government sources, according to manufacturer reports, was 6,290 tons, which falls 37 percent short of the actual 10,026 tons collected by local governments during the same fiscal year. Separate information from local government reports indicates that only three of the four companies directly receiving quota from television manufacturers actually received material from local programs, making the actual shortfall 43 percent. Moreover, in comparing manufacturer reports with data from communities, five R2 certified electronics recyclers actually serving local programs received no direct TV manufacturer support at all in Fiscal Year 2014-15<sup>11</sup>.

TV manufacturers meet part of their obligation by arranging for recycling of additional tonnage through non-governmental sources, including retail locations (most notably at Best Buy stores) and Goodwill stores. In Fiscal Year 2014-15, manufacturers reported recycling 2,834 tons from non-government sources; when added to local government tonnage, the total amount of televisions recycled in North Carolina for the fiscal year was 12,860 tons. However, recycled tonnage reported having been supported by all TV manufacturers from all sources adds up to 9,124 tons in Fiscal Year 2014-15, which is 29 percent less than the actual total tonnage recycled. The cost of this shortfall has fallen mainly on local programs.

In addition to the gap in tons of television recycling supported by television manufacturers, the television manufacturer support that is injected into the North Carolina system may fail to adequately fund the television recycling that manufacturers do support. According to electronics recyclers that receive manufacturer quota in North Carolina, television manufacturer payments do not cover the actual costs of processing CRT and FPD displays. Electronics processors with TV quota who also serve community programs consistently report receiving payments for processing CRTs in the range of 12 to 18 cents per pound. Market rates to receive, prepare, and deliver CRTs to lead smelters and other industrial market are generally now in the range of 30 cents per pound or more. As further evidence of inadequate manufacturer payments, local governments with recently established contracts from recyclers who have manufacturer quota are being charged rates above 10 cents per pound for CRTs, an indication that TV manufacturer payments are fail to cover the full costs of managing the materials. In addition, it appears that most television manufacturers also procure their quota late in the fiscal year,

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<sup>11</sup> R2 is one of voluntary two certification standards for electronics recycling companies, established to help ensure that recyclers follow best practices in the handling and marketing of electronic materials. North Carolina local governments must use a recycler certified under either R2 and e-Stewards, the other voluntary certification standard, in order to be eligible for Electronics Management Fund distribution. More information on the R2 standard can be found at: <https://sustainableelectronics.org/> and on e-Stewards at <http://e-stewards.org/>.

which leads to uncertainty in terms of when and how recyclers can transfer the benefits of quota to local government clients.

A final challenge in regard to TVs is that the overall denominator by which NC DEQ has been assigning recycling obligations to TV manufacturers is falling short of what is actually collected. For Fiscal Year 14-15, for example, DEQ used the denominator of 21,000,000 pounds, or 10,500 tons to assign TV manufacturer quotas. Actual TV collection in Fiscal Year 2014-15 was 12,860 tons, or 23 percent more than the total quota assigned. DEQ again assigned quotas for Fiscal Year 2015-16 using a denominator of 21,000,000 pounds; trends in TV collection make it likely that actual TV recovery will exceed this figure. In addition to the issues described above, this will further dilute television manufacturer support of the system, shifting the balance of the costs to local government programs.

Electronics Management Fund

The Electronics Management Fund is the source of support for DEQ’s administration of the electronics recycling law and also for per capita distributions to local government electronics collection programs. Local governments make themselves eligible for funding by establishing an approved electronics management plan and by contracting with a certified environmentally responsible electronics recycler. Local governments receiving distributions from the Fund are required to use the funding solely for the operation of public electronics recycling programs. The table below shows total revenues, balances, and distributions to eligible communities since the beginning of the program. Distributions are made to local governments in February of every year, using a balance of funds available from manufacturer registration fees in the previous summer and fall. As can be seen in the table, the relative high level of registration revenues in FY 2014-15 of \$1,027,500 made possible the highest distribution to date of \$859,000 in February 2016. The projected receipt of an additional \$1 million in FY 2015-16 should translate into a similar level of payment to communities in February 2017.

Fiscal History of North Carolina Electronics Management Fund

Fiscal Year	Beginning Fund Balance	Fiscal Year Revenues*	Expenditures		Ending Fund Balance
			Funds Used for Program Administration	Funds Used for Distributions to Local Government	
FY 2010-11	\$0	\$987,500.00	\$5,000.00	\$465,500.03	\$516,999.97
FY 2011-12	\$516,999.97	\$585,000.00	\$37,538.16	\$600,000.03	\$464,461.78
FY 2012-13	\$464,461.78	\$462,500.00	\$40,628.83	\$483,390.68	\$402,942.27
FY 2013-14	\$402,942.27	\$705,000.00	\$64,169.02	\$600,000.00	\$443,773.25
FY 2014-15	\$443,773.25	\$1,027,500.00	\$77,389.44	\$690,174.76	\$703,709.05
FY 2015-16	\$703,709.05	Projected \$1,000,000.00	Projected \$78,000.00	Projected \$859,000.00	

As noted above, a factor that reduces financial support available to local recycling programs from the Electronics Management Fund is the amount of Level II computer manufacturer registrations each year. If all computer manufacturers had registered at Level I in Fiscal Year 2014-15, payments to local programs from the Electronics Management Fund would have been approximately 28 percent higher for the February 2016 distribution.

### Assessment of Public Electronics Recycling Programs

As conceived in the formation and implementation of the electronics legislation, local governments play a central role in providing electronics recycling opportunities to citizens, diverting materials away from disposal and to the electronics recycling economy. Some local governments started electronics collection programs in the early 2000's, while many others started programs with the passage of the electronics law. The legislation does not mandate the operation of local programs, nor does it dictate how local programs are to be financed. However, the law does provide for some financial support to local programs through the Electronics Management Fund under conditions discussed above. An examination of the performance and experience of these programs helps to gauge the status of the collection system as a whole.

During Fiscal Year 2014-15, 85 counties and 3 municipalities were eligible to receive electronics management fund distributions. In an attempt to assess the state of the public electronics recycling systems, DEQ sent a detailed electronics recycling survey to these 88 local governments and had a response rate of 73 percent (a copy of the survey is available in Appendix B of this study). The survey requested information for Fiscal Year 2014-15 and for Fiscal Year 2015-16 year-to-date with questions addressing the range of programmatic costs and the materials handled. The 64 responding governments manage 292 individual collection sites on behalf of the public.

Survey questions were asked to determine the range of types of televisions and other electronics handled by local government electronics recycling programs. Every program surveyed accepts and recycles all of electronic equipment defined by G.S. 130A-309.131 as being covered by the state's electronics management program and that are banned from disposal. Covered electronic devices include televisions, computers, monitors, printers, scanners, combination print-scanner-fax machine, and/or other devices designed to produce hard paper copies from a computer. Keyboards and mice are not covered. Some programs limit their collection to these statutory materials. Other programs accept additional types of electronic equipment that, while not banned from disposal, are readily recyclable and accepted by electronics recyclers. Examples include cell phones, stereo equipment, telephone equipment, VCRs, DVD players, wires and cable, and photocopiers.

As shown in the table below, survey results indicate that Flat Panel Display (FPD) Televisions represent seven percent of the televisions recycled by local programs. Cathode Ray Tube (CRT) Televisions still account for 93% of the televisions managed, but the percentage of FPD televisions that citizens are bringing to collection programs is gradually increasing.

Television Types Collected in Local Programs, Fiscal Year 2014-15 and Fiscal Year 2015-16 To-Date

Fiscal Year	CRT TVs Percentage	FPD TVs Percentage
2014-15	93.2%	6.8%
2015-16 YTD	93.0%	7.0%
Two Year Average	93.1%	6.9%

When examining the equipment handled by public programs beyond televisions, survey data reveals that approximately half of the material collected is not covered by the state disposal ban. Computer monitors represent a just over a quarter of the equipment collected and other covered devices make up just under a quarter. The additional equipment collected for recycling - such as DVD players, games, and



other consumer electronics - indicates that both citizens and community program have a strong desire to divert a wide range of electronics from disposal.

Types of Non-Television Electronic Equipment Managed by Local Government Programs

Equipment Type	FY 2014-15 Percentage	FY 2015-16 Percentage	Combined Period
Monitors	26.1%	29.0%	27.0%
Other Covered Devices	25.1%	18.0%	22.0%
Other Electronic Materials	48.8%	53.0%	51.0%
Total	100.0%	100.0%	100.0%

An analysis of the entire stream managed by the local governments completing the survey reveals that televisions comprise nearly 60% of the total materials handled by community programs. The following table illustrates the overall proportion each type of equipment represents in the recovered stream.

Types of Equipment Recovered by Local Programs

Equipment Type	FY 2014-15 Percentage	FY 2015-16 YTD Percentage
CRT Televisions	55.0%	56.8%
FPD Televisions	4.0%	4.3%
Computer Monitors	10.7%	11.3%
Other Covered Devices	10.3%	7.0%
Non-Covered Devices	20.0%	20.6%
Total	100.0%	100.0%

The survey results above are consistent with statutory Local Government Solid Waste and Materials Management Annual Report data received by DEQ, which shows that two thirds of equipment managed by public electronics recycling programs in FY 2014-15 were televisions. A detailed analysis of a selection of the survey responses indicates that local governments may inadvertently report computer monitors as TVs when calculating television tonnage. For this reason the data gathered in the Annual Report process may slightly overstate the televisions as portion of the local government managed electronics stream. The following table presents Local Government Annual Report electronics recycling data for FY 2014-15.

Local Government Annual Report Data for Fiscal Year 2014-15

Type of Equipment	Tonnage	Percentage
Televisions	10,025.66	66.5%
Other Electronic Equipment	5,050.77	33.5%
Total	15,076.43	100.0%

To manage electronics, local governments experience a range of cost that can be broken down into two broad categories: 1) expenses paid to electronics recyclers for receiving the collected materials, and 2) expenses of establishing and operating collection services.

The economics of electronics recycling is closely connected with the recovery of materials common in electronics equipment such as aluminum, steel, copper, plastic, and precious metals such as gold, palladium, platinum, and silver. In addition to containing these kinds of valuable materials, electronic

equipment also contains toxic materials such as lead, mercury, beryllium, cadmium, brominated flame retardants and a variety of batteries which also contain heavy metals. The value of a wide range of commodities has declined significantly during the past two years, and as this has happened revenues from the materials with positive value in the electronic discard stream are less able to help offset the cost of processing and managing the toxic and difficult to handle materials. The pressures associated with the changes in materials value have impacted the overall cost of electronics recycling, and this change has been felt acutely by public recycling programs. The following table provides a look at the fees paid by survey respondents to their electronics recycling companies during Fiscal Year 2014-15 and Fiscal Year 2015-16 year to date, and illustrates this change.

Payments to Electronics Recyclers Reported by Survey Respondents

FY 2014-15	FY 2015-16 YTD	Percent Increase
\$ 585,218.14	\$ 2,364,493.82	304.0%

The expenses noted in the above table for FY 2015-16 only reflect the fees paid to electronics processors for a portion of the Fiscal Year. It is projected that the total amount paid to electronics recycling contractors for the full fiscal year will have increased at least five-fold over the previous year.

The fees charged by electronics recycling contractors cover a range of expenses, including charges for collecting and transporting materials from local government sites to company facilities, for processing specific types of equipment, and for managing materials with toxic properties and negative values. Other costs include charges for materials and supplies such as boxes and shrink wrap. A more detailed look at the types of expenditures paid to electronics recycling companies appears in the table below.

Breakdown of Fees Paid to Electronics Recycling Companies by Local Governments

Vendor Cost Item	FY 2014-15 Percentages	FY 2015-16 YTD Percentages
Television Recycling Fees	53.6%	82.3%
Computer Monitor Recycling Fees	2.2%	2.3%
Transportation Charges	25.8%	8.7%
Other Charges	18.4%	6.7%
Total	100.0%	100.0%

The fees paid to vendors for television recycling have increased markedly. During FY 2014-15 and years prior to that, electronics recycling companies were able to subsidize or offset the cost of recycling televisions by using surplus revenues from commodities with positive value. As commodity values have recently declined, revenues are no longer available to help cover the cost of processing televisions and monitors, and recycling companies have had to turn to their local government clients with fees to fund the full cost of processing. It is important to note that this has occurred as television manufacturer payments to recyclers have stayed flat and have fallen short of covering the total tonnage that local governments collect. As discussed above, manufacturers are also not using some key R2 certified vendors that serve local programs.

In addition to fees paid to electronics recycling companies, local governments also have operational expenditures associated with their electronics recycling systems. Local government operating expenses include labor for handling materials and managing programs, whether paid to public employees or contract staff. Programs also experience costs for program materials and supplies, maintenance and

repair for trucks and equipment, and other expenses such as fuel and utilities. Data from survey respondents on the different operating costs paid by public programs are illustrated below.

**Breakdown of Local Recycling Program Operating Expenditures**

<b>Expense Item</b>	<b>FY 2014-15</b>		<b>FY 2015-16 YTD</b>	
Labor	\$ 734,643.70	53.1%	\$ 516,621.08	47.0%
Materials/Supplies	\$ 71,942.51	5.2%	\$ 46,166.14	4.2%
Other Contract Costs	\$ 482,844.92	34.9%	\$ 469,355.74	42.7%
Maintenance and Repair	\$ 23,519.67	1.7%	\$ 16,487.91	1.5%
Other	\$ 70,559.00	5.1%	\$ 48,364.53	4.4%
<b>Total</b>	<b>\$ 1,383,509.80</b>	<b>100.0%</b>	<b>\$ 1,099,193.78</b>	<b>100.0%</b>

To assist with the cost of providing electronics recycling services, some community programs earn revenues from the sale of high-value electronics. Revenue can be maximized by sorting and consolidating materials of value and by implementing systems to prevent scavenging of valuable materials. In addition to earning revenues from materials sales, some local governments have implemented fees charged to citizens for recycling services, which is allowed under the legislation. The following tables provide an overview of program revenues reported by survey respondents.

**Local Governments Revenue from Sale of Materials**

<b>Year</b>	<b>Percent of Respondent Governments Earning Revenue From Material Sales</b>	<b>Revenue Earned</b>
FY 2014-15	29.7%	\$ 90,770.76
FY 2015-16 YTD	28.1%	\$ 28,545.09

**Local Governments Charging Citizen Fees to Recycle Electronics**

<b>Percent of Survey Respondents Utilizing Citizen Fees</b>	<b>18.8%</b>
<b>Items For Which Local Governments Charge Fees</b>	
Televisions	100.0%
Monitors	75.0%
Other Equipment	33.3%
<b>Total Revenue Reported from Citizen Fees</b>	
<b>Year</b>	<b>Total Revenue Reported from Citizen Fees</b>
FY 2014-15	\$ 71,674.00
FY 2015-16 YTD	\$ 100,246.00

In addition to revenue from sales of materials and citizen fees, local governments may also make themselves eligible for distributions from the state’s Electronics Management Fund. In Fiscal Year 2014-15, 109 local governments reported electronics recycling tonnage in their Local Government Solid Waste and Materials Management Annual Report. Only 88 of those governments made themselves eligible for electronics management fund distributions. Since the advent of Electronics Management Fund distributions, the Division of Environmental Assistance and Customer Service has advised local governments to utilize those funds to build infrastructure and to acquire capital equipment that will enable the more efficient management of electronics collected for recycling.

By combining the expenses paid to electronics recycling contractors with the expenses for local government program operations it is possible to begin to characterize the full gross cost of the public electronics recycling programs operated by survey respondents. When revenues from the sale of equipment and citizens fees are taken into account and applied against program expenditures, a picture of the net cost for public electronics recycling programs comes into focus. Revenues from the state Electronics Management Fund are not included in this analysis, but those funds partially offset program costs for the communities that have made themselves eligible for distributions.

**Local Government Electronics Recycling Program Costs and Revenues**

Expense Item	FY 2014-15	FY 2015-16 YTD
Contractor Fees	\$ 585,218.14	\$ 2,364,493.82
Program Operating Expenses	\$ 1,383,509.79	\$ 1,099,103.78
Gross Total Program Cost	\$ 1,968,727.93	\$ 3,463,597.60
Revenue from Sales of Materials	\$ 79,855.85	\$ 26,336.07
Revenue from Citizen Fees	\$ 71,674.00	\$ 100,246.00
Net Program Cost	\$ 1,817,198.08	\$ 3,337,015.53
Full Cost / Pound Managed	\$ 0.083	\$ 0.245

The cost per pound managed as determined from survey responses can be applied to the full amount of electronics tons reported as recycled by local governments in the Solid Waste and Materials Management Annual Report to project the full cost of operating the local government electronics recycling system in North Carolina. As noted above and in the table below, the cost per pound for operating local electronics recycling programs in FY 2015-16 has increased 295.2% over FY 2014-15.

**Projected Full Cost of Public Electronics Recycling System in North Carolina**

Year	Tons Managed	Cost Factor	Full Cost
FY 2014-15	15,076.43	\$0.083/lb.	\$ 2,502,687
FY 2015-16 <sup>1</sup>	15,076.43	\$0.245/lb.	\$ 7,387,451

1 – the total tonnage for FY 2015-16 is not known so FY 2014-15 tonnage is used for the sake of analysis to calculate an estimated full local government system cost for FY 2015-16.

Local electronics recycling programs vary widely in their efficiency and effectiveness. The average local government electronics recycling program operating during FY 2014-15 collected 3.19 pounds of electronics per capita. The most productive individual program in the state reported collecting 13.39 pounds of electronic equipment per capita, while the least productive program reported collecting just 0.04 pounds of electronic equipment per capita.

As indicated earlier, survey data reveals that the average full operating cost during FY 2014-15 was \$0.083 per pound and the average full operating cost reported YTD in FY 2015-16 is \$0.245 per pound collected. As with the range in per capita collection rates, there is also a wide range in operating costs for different public programs. The range of costs experienced can be seen in the following table.

**Review of Public Electronics Program Operating Costs (cost/pound)**

Year	Lowest Operating Cost	Highest Operating Cost	Average Operating Cost
FY 2014-15	\$ (0.030)	\$ 2.050	\$ 0.169

2015-16 YTD	\$	-	\$	2.510	\$	0.235
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A review of survey responses indicate that during Fiscal Year 2014-15 there were four (4) public programs that reported earning a net profit associated with their public electronics recycling programs and five (5) programs reported operating at no net cost. For FY 2015-16 year-to-date, no programs report operating with a net profit and twelve (12) programs report experiencing no cost to date. It is possible that some of the programs serving less populous communities that report no YTD expenses may have not yet shipped loads to their recycling vendor.

The following table explores the full range of costs reported by survey respondents for the two years in question.

Full Cost Analysis of Public Electronics Recycling Programs Responding to Survey

Cost Range (\$ per pound)	# of Communities	
	FY 2014-15	FY 2015-16
< 0 (earned net revenue)	3	0
\$0 (no cost)	5	12
\$0.001 - \$0.05/lb.	17	5
\$0.051 - \$0.10/lb.	14	5
\$0.101 - \$0.15/lb.	8	4
\$0.151 - \$0.20/lb.	3	8
\$0.201 - \$0.25/lb.	2	9
\$0.251 - \$0.30/lb.	0	7
\$0.301 - \$0.35/lb.	1	2
\$0.351 - \$0.40/lb.	0	4
\$0.401 - \$0.45/lb.	4	1
\$0.451 - \$0.50/lb.	1	0
> \$0.50/lb.	4	5

This range of expenses points to opportunities for increased efficiency and cost effectiveness in local programs. The process of identifying and implementing cost-savings measures is continual and by no means complete among local government programs in North Carolina. Section 3 of the report below on Opportunities for Efficient and Effective Electronics Recycling discusses best management practices that directly affect local program costs. It should be noted that many of the same communities show consistently high program costs year over year, and those programs paying in excess of \$0.40/pound have failed to implement many of the best management practices that will be reviewed in Section 3 of this report.

#### Market Conditions and Prices

Market prices for most recyclable commodities have been relatively weak since 2014 due to a number of factors, including a slowdown in Chinese demand for secondary materials, a strong U.S. dollar that raises the cost of recyclable exports and lowers the cost of imported finished recycled content products such as steel and aluminum, and persistently low oil prices, which directly reduces the value of recovered plastic which competes against plastics produced using virgin crude. The major commodities produced from electronics – ferrous, non-ferrous, and precious metals, and plastics – have all been

affected directly by this market downturn, lowering prices for both positively and negatively valued electronic products (these same market conditions are affecting prices for a wide range of other materials that local governments collect, including paper, plastic containers, aluminum cans, white goods, and used motor oil). Although commodity markets experience natural price swings over the course of time, it is difficult to predict when current price conditions might change. Recent market activity seems to indicate a levelling of prices at their current low end.

One perspective on the current state of prices for electronics commodities can be found in recent bids for the state electronics contract, a process coordinated by DEQ with the North Carolina Department of Administration. Although this contract, which state agencies are required to use and which local governments may use as a convenience contract, will not be officially available until April 1, the cost bids from six main vendors can be averaged for a range of electronic products. Those averages are displayed in the table below, along with the ranges of the individual cost bids.

Per Pound Cost Bid Summary for 2016 State Electronics Contract

Commodity	Range of Cost Bids (price is per pound)	Average
CRT Televisions	-\$ .30 to -\$ .44	-\$ .36
Flat Panel Televisions	-\$ .15 to -\$ .35	-\$ .24
CRT Monitors	-\$ .25 to -\$ .35	-\$ .31
Flat Panel Monitors	-\$ .15 to -\$ .28	-\$ .19
Desktop computers	+\$ 0 to +\$ .14	+\$ .08
Laptop computers	+\$ .05 to +\$ .60	+\$ .30
Printers/Scanners/Copiers	-\$ .05 to -\$ .25	-\$ .14
Consumer electronics	-\$ .05 to -\$ .25	-\$ .15
Tablets	-\$ .20 to +\$ .15	-\$ .01
Cell phones	\$ 0.00 to \$ 2.50	+\$ .96

These prices are only one indication of the kinds of charges local governments are receiving from electronics recyclers. According to electronics recycler quotes recently provided to some local governments, more favorable pricing can be received when a recycler has TV manufacturer quota and when the community program is known for properly managing the recyclables that they receive and for preparing materials to vendor requirements. The survey of local programs confirms that local governments can obtain more favorable pricing, with 20% of respondents indicating that they are experiencing television recycling costs of under \$0.20/pound during the current fiscal year.

### Section 3: Opportunities for Efficient and Effective Electronics Recycling

There are many examples of effective local government operated electronics recycling programs in North Carolina. These programs respond to the public demand for electronics recycling services and to the state disposal ban by providing their citizens a service that is readily accessible and operated efficiently. When local governments embrace electronics recycling as a public service and approach the provision of this service with the understanding that electronics recycling includes a commitment of resources in proper equipment and infrastructure, electronics recycling can be highly compatible with existing solid waste and recycling activities and can be performed responsibly and at a reasonable cost.

From the earliest days of electronics recycling collection in North Carolina, with pioneering programs that preceded the implementation of the state electronics laws, a consistent set of best management

practices have helped ensure greater efficiency and cost effectiveness in local program operations. The best management practices, which still apply today, include:

- Providing citizens with easy access to secure electronics recycling options so that material is not handled in a way that creates opportunities for damage or pilfering,
- Reducing opportunities for scavenging to the greatest degree possible,
- Developing systems that reduce the number of times equipment is handled,
- Consolidating small collected loads into larger truckloads to minimize transportation costs,
- Sorting and packing materials in accordance to recycler specifications to maximize value and truckload weights,
- Managing collected materials with reuse in mind by handling materials with reuse value to avoid breakage, for example by packing flat panel monitors to prevent screen damage,
- Collecting from sources with higher value materials – i.e., small commercial and institutional generators of computer equipment including local government and public school systems,
- Connecting citizens with a range of recycling options including manufacturer sponsored take-back programs, retailer-sponsored programs, and local charitable organizations that not-only welcome donations or certain types of electronics but that handle the electronics they receive responsibly, and
- Providing all collected materials to a single vendor, rather than splitting loads to multiple vendors.

The DEQ survey of local programs, in addition to the Department's efforts to observe and provide technical assistance to local programs, helps underscore these best management practices.

It is also clear from the local government survey that communities can make better use of data on their programs and the associated costs. DEQ found substantial gaps for some communities between the electronics tonnages they provided in the survey and what they provided in their Local Government Annual Reports. It appears in some cases that local governments do not closely examine vendor invoices or use them to better understand the true nature of their program tonnage and expenses. Although often overlooked, good record-keeping and program measurement can be very helpful tools in identifying and implementing cost efficiencies.

Looking at the broader system, overall efficiency can be enhanced if the combined resources supporting electronics recycling in North Carolina are focused on efforts where the majority of materials are being handled. This principle underscores the need to re-examine computer manufacturer registration levels II and III, which are failing to capture any appreciable amount of material in the system relative to local government operations. It also underscores the need to improve the connections between which recyclers TV manufacturers use to recover their annual quota and which recyclers local governments use for their material markets.

#### **Section 4: Additional Information from the Department**

##### Economic Development and Employment Impact of Electronics Recycling in North Carolina

North Carolina's electronics legislation has helped attract a substantial amount of in-state private sector investment in electronics processing. As a home to five major processing facilities and an additional number of smaller companies, the state's economic development around this sector outstrips that of

surrounding states, with 22 separate R2 Certified electronics recyclers in North Carolina, compared to 16 in Virginia, 10 in Tennessee, and just 3 in South Carolina. Investment in plant and equipment for electronics processing in North Carolina exceeds \$55 million and the sector accounts for an estimated 600 direct jobs as well as supporting indirect jobs in trucking, construction, and supplies. In many cases, electronics processors are turning old abandoned industrial sites into operational facilities, and many are located in rural areas of the state, including Granville, Rockingham, Rowan, and Stanly counties. The electronics recycling sector relies on the supply of material now well established under North Carolina's electronics recycling legislation. It is a dynamic part of the state's economy, able to react quickly with additional investment and able to adapt to the processing of new products, including a possible supply of solar panels when they reach the end of their useful life.

#### Analysis of Cathode Ray Tube (CRT) Markets

With a flow of discarded CRT TVs and monitors still to be expected in coming years, it is important to examine the status of CRT recycling markets. These markets have shifted as CRT manufacturing, which is the ideal use for recycled CRT glass, has declined. Recently the only CRT maker in the world that could use CRT glass, Videocon in India, had temporarily ceased operations but has since re-started.

But it is clear that this market is limited and that CRT glass must therefore go to other industrial uses, which are detailed below. For this study, DEQ conducted extensive conversations with electronics recyclers, industry observers, and some of the main secondary processors of CRT glass described below. CRTs collected in North Carolina are going to a variety of markets, all of whom have an ongoing appetite for more material. In summary, there appears to be no immediate demand barrier to continuing to collect and divert CRTs from landfills in North Carolina.

CRT glass recycling markets can be divided into two main categories, the first of which is designed to extract the lead and the second of which reprocesses the CRT glass for new products without extracting the lead. Under the first category, lead smelters use CRT glass as fluxing agent and as a method to recover lead (copper and zinc smelters may also be able to use CRT glass as a fluxing agent). CRT glass tends to be a small component of the overall material being smelted. Operating smelters actively consuming CRT glass in North America include:

- Glencore (formerly Xstrata) in eastern Canada
- Doe Run Company in Missouri
- Teck Resources Teck Cominco facility in western Canada

The Glencore and Doe Run facilities have received material from North Carolina recyclers who are sourcing CRTs from local government recycling programs; Glencore in particular has an ongoing North Carolina-based supply being delivered through the secondary processor Novotec in Ohio. It is unlikely that any North Carolina material is going to Teck Resources or to another lead smelter consumer of CRT glass, such as Korea Zinc in South Korea.

In addition these larger operations, one smaller scale company, NuLife, operates furnaces that are specifically designed to extract lead from CRT glass. The company's New York facility started operating in February 2016 and its Virginia facility will be operational after 2017.

Under the second category of CRT recycling, leaded glass is processed for new products without necessarily removing or separating the lead from the glass. A very common and increasingly important industrial usage in this category is tile manufacturing. This market has experienced an accelerated



momentum with the emergence of Camacho in Spain, a secondary processor that prepares glass for tile manufacturers in Europe. At the end of 2015, Camacho started to receive a large amount of CRT material from North America, including supplies from North Carolina. Another company, COM2 Recycling Solutions in Illinois, is also actively receiving material from North Carolina and is processing CRT glass for domestic tile manufacturing, preparing the tile in such a way as to neutralize or seal the lead. Beyond tile recycling, Dlubak Glass in Ohio receives CRTs and creates customized glass cullet blends for specialty glass products with lead content. Other non-lead smelter markets include Closed Loop, which uses CRT glass as an aggregate for concrete and as a feedstock for fiberglass insulation and has stated that it also wants to build smelting capacity. An overseas market with a somewhat similar approach is Jansen BV in Holland, which supplies a concrete brick market.

The combination of the lead smelter and other industrial products markets translates into a consistent demand for CRT glass, even if those markets source CRTs as a negatively priced commodity. An intermediate network of processors receives and prepares CRT glass for end uses, providing a link between primary electronics recyclers who receive collected materials from community programs and the eventual end-users. These companies include:

- ECS Refining, a company that processes CRT panel glass for a number of applications including automotive, fiberglass, bead and lighting industries,
- Electronic Recyclers International (ERI), which, according to its Website, operates “proprietary glass cleaning technology that separates the panel glass from the funnel glass. All Phosphors and other hazardous substances are cleaned from the inside of the tube and managed as necessary, and glass is cut and cleaned and sent for remanufacturing,”
- Novotec Recycling, which processes intact televisions and monitors and CRT tubes for shipment to the Glencore smelter in Canada. Novotec has invested in equipment to prepare glass to Glencore’s desired specification and may have an exclusive relationship with Glencore for CRT glass coming from the US,
- Regency Technologies, which processes intact televisions and monitors as well as cleaned whole CRT tubes and then sends them to Dlubak for further processing.
- Technologies Displays Mexicana (TDM) / Cali Resources, which formerly processed CRTs and sent CRT Glass to Videocon in India TDM and which now processes CRT glass and ships it to Camacho in Spain for use in tile and other ceramic products. TDM may have additional outlets for CRT glass as well,
- Total Reclaim, a West Coast based company with facilities in Seattle and Alaska, that processes televisions and monitors, but only equipment from its own collection operations. Total Reclaim indicates that they send CRT glass to the Teck Cominco smelter, to TDM, and directly to Camacho in Spain, and
- Compupoint in Atlanta, which is actively receiving material from North Carolina, processes CRTs for shipment to both Camacho and to some non-lead glass paving material markets in the U.S.

A final kind of outlet for CRT glass is related to landfill usage, either as an alternative daily cover material or as stored in a landfill-like cell designed for the CRT glass to be retrieved at a later time.

- URT Solutions is a company that has indicated that it can prepare glass for use as ADC. However this company may have recently been fined by the state of New Hampshire, reference: <http://resource-recycling.com/node/6890>

- Kuusakoski Recycling is an Illinois based company that operates a system where CRTs are processed, the non-glass components of the CRT are recycled, and the CRT glass is chemically treated to encapsulate the lead. Kuusakoski Recycling has a partner company, Peoria Disposal Company (PDC), who operates three landfills in Illinois. According to the Kuusakoski web site the “treated glass is stored in an EPA certified and monitored mineable cell for storage until economically viable scalable processes for separating lead from glass becomes available.” Kuusakoski has recently bought Vintage Tech, an intermediate CRT processor with a number of locations in the U.S. Vintage Tech was one of the four companies TV manufacturers used to fill their North Carolina quota in Fiscal Year 2014-15, but which none of the local governments listed as a market.

#### Flat Panel Display Management Options

At this point, FPD televisions and monitors do not appear to face any market demand limitations. Electronics recyclers are able to successfully process FPDs for their material commodity and component values. There appears to be a good ongoing reuse market for FPD monitors in particular, especially if they are handled carefully in the collection process.

However, the inherent commodity value of FPDs, outside of a reuse market, translates into a negative value post-collection. The first generation of FPDs, Liquid-Crystal Display (LCD) monitors and televisions, present the need to remove Cold Compact Fluorescent Lights (CCFLs), which were used as the back light for the display. CCFLs, as with other fluorescent lamps, contain mercury and are considered Universal Wastes. If FPD monitors are damaged during collection they tend to be rendered unacceptable for reuse and must be recycled in a manner that responsibly handles the CCFLs and reclaims the mercury. The need for such processing is this reason why recycling FPDs containing CCFLs will continue to present a cost to the system (refer to the table in Section 2 of this report titled “Per Pound Cost Bid Summary for 2016 State Electronics Contract” for a current estimate of this cost).

The main second generation FPD technology, Light-Emitting Diode (LED) monitors and televisions, use LEDs instead of CCFLs to provide the backlight, thus eliminating the issue of mercury. A newer technology, Organic Light-Emitting Diode (OLED) monitors and televisions, also do not contain mercury. Once generated as discards in the next 10 to 15 years, LED-based FPDs may be the first generation of displays that do not include a toxicity challenge in the dismantling process.

#### **Report Conclusion and Study Recommendations**

North Carolina has a robust recycling collection system that gives its citizens the opportunity to recycle practically every piece of electronic equipment they purchase and use. This collection system diverts more than 19,000 tons of electronic equipment and their related commodities from landfills each year, delivering those materials to a largely in-state and economically important primary processing infrastructure that then distributes the products and commodities into a larger, global marketplace.

North Carolina’s system relies heavily on local governments to provide electronics recycling service to citizen. Recent negative market conditions, combined with shortfalls in television manufacturer support and reduced computer manufacturer payments from Level II registration, have resulted in a heavier financial burden on local programs to run the system. The recommendations below seek to address

these issues and to allow North Carolina to continue to enjoy the multiple and substantial economic and environmental benefits of electronics recycling.

#### DEQ Programmatic Recommendations

- DEQ should assign television recycling targets that are more in line with actual collected tonnage and with the trends in that collection.
- DEQ should explore seeking more detailed information in manufacturer annual reports to allow more accurate accounting of total TV tonnage, to better track how well TV manufacturer quotas are supporting local government collection programs, and to determine to what degree television manufacturers are using responsible end markets.
- DEQ should consider using Mercury Pollution Prevention funds as supplemental payments to local governments for the collection of LCD televisions and monitors, which contain mercury lamps.
- DEQ should modify reporting mechanisms for both local governments and manufacturers to separately track collection of CRT and FPD televisions.

#### Legislative Recommendations

- The General Assembly should consider legislation to balance cost obligations more equitably between computer manufacturers, television manufacturers, and local governments. Examples of possible adjustments include:
  - Eliminating Levels II and III for computer equipment manufacturer registration, which would simplify the registration process and provide additional funding to local electronics programs that are recovering the vast majority of computer equipment.
  - Setting a prescribed annual reimbursement rate for television manufacturer payments to processors that are handling local government television tonnage.
  - Requiring television manufacturers to use electronics recycling processors who are actively serving North Carolina local government collection programs.
  - Providing clear authority to DEQ to collect the data from manufacturers that is needed to ensure proper system functioning.

#### Local Program Recommendations

- Local government programs should continually seek to implement best management practices in the handling of televisions and computer equipment, including:
  - Reducing scavenging to the greatest degree possible.
  - Developing systems that reduce the number of times equipment is handled.
  - Managing materials with reuse in mind – e.g., handle and pack flat panel monitors to prevent damage.
  - Consolidating small collected loads into larger truckloads.
  - Sorting and packing materials in accordance to recycler specifications to maximize value and truckload weights.
  - Dedicating all collected tonnage to a single certified recycler to ensure that materials with positive value are available to help offset the cost of materials with negative value.
- Local government programs that do not already do so should consider collecting from sources with higher value materials – i.e., small commercial and institutional generators of computer equipment including local government and public school systems.

- Local government programs should take advantage of detailed documentation in recycling invoices to better track the costs and flow of electronic materials, in particular to track the changeover of CRTs to FPDs in collection programs.

## Appendix A: Study Sources

- North Carolina 2016 Solid Waste and Materials Management Report, NC DEQ
- Local Government, Computer Manufacturer, and Television Manufacturer Annual Reports to NC DEQ
- DEQ Survey of Local Government Electronics Recycling Programs, January 2016
- USEPA. *Electronics waste management in the United States (approach 1)*. U.S. Environmental Protection Agency (USEPA). Washington, DC, US, 2008.
- USEPA. *Electronics waste management in the United States through 2009*. U.S. Environmental Protection Agency (USEPA). Washington DC, US, 2011.
- Quantitative Characterization of Domestic and Transboundary Flows of Used Electronics - Analysis of Generation, Collection, and Export in the United States, Massachusetts Institute of Technology, December 2013: [http://www.step-initiative.org/files/step/\\_documents/MIT-NCER%20US%20Used%20Electronics%20Flows%20Report%20-%20December%202013.pdf](http://www.step-initiative.org/files/step/_documents/MIT-NCER%20US%20Used%20Electronics%20Flows%20Report%20-%20December%202013.pdf)
- State of Florida Electronics Residential Survey 2003 Report, [http://www.dep.state.fl.us/waste/quick\\_topics/publications/shw/electronics/FloridaElectronicsResidentialSurvey2003ReportCorrected.pdf](http://www.dep.state.fl.us/waste/quick_topics/publications/shw/electronics/FloridaElectronicsResidentialSurvey2003ReportCorrected.pdf)
- “New Tech to Drive CE Industry Growth in 2015 – Projects CEA’s Midyear Sales and Forecast Report Consumer” - <https://www.cta.tech/News/News-Releases/Press-Releases/2015-Press-Releases/New-Tech-to-Drive-CE-Industry-Growth-in-2015,-Proj.aspx>
- Consumer Electronics Industry Revenues to Reach All-Time High in 2014, Projects CEA’s Semi-Annual Sales and Forecasts Report” - <https://www.cta.tech/News/News-Releases/Press-Releases/2014/Consumer-Electronics-Industry-Revenues-to-Reach-Al.aspx>
- Presentation: “CEA 2015 Consumer Survey - CRT Televisions and Monitors Per US Household” Walter Alcorn, Consumer Electronics Association (now Consumer Technology Association) 2015 ERCC Meeting @ E-Scrap Conference, September 1, 2015
- Presentation: “The FPD Era” Bobby Elliot, Associate Editor, E-Scrap News 2015 E-Scrap Conference, September 1, 2015
- Presentation: “What’s the Fuss about CRT Glass?” Eric Harris, Associate Counsel, Director of Government and International Affairs, ISRI January 12, 2016 State Electronics Challenge Webinar
- Presentation: “What’s the Fuss about CRT Glass?” Jim Levine, President, Regency Technologies January 12, 2016 State Electronics Challenge Webinar
- U.S. Census, *Computer and Internet Use in the United States* <https://www.census.gov/history/pdf/2013comp-internet.pdf>
- Statista - Share of selected types of computers on all PC sales from 2008 to 2015 in the U.S. <http://www.statista.com/statistics/269173/pc-sales-by-computer-type-from-2008-to-2015-in-the-us/>
- “Quantitative Characterization of Domestic and Transboundary Flows of Used Electronics - Analysis of Generation, Collection, and Export in the United States,” Huabo Duan, T. Reed Miller, Jeremy Gregory, and Randolph Kirchain Massachusetts Institute of Technology, December 2013.
- Consumer Electronics Association, 2005 “CE Ownership and Market Potential” Covered in: <http://www.businesswire.com/news/home/20050517005989/en/Household-Penetration-CE-Products-Soars-2005-Ownership>

Appendix B: DEQ Local Government Electronics Recycling Program Survey

**Local Government 2016 Electronics Recycling Survey**  
**NC Division of Environmental Assistance and Customer Service (DEACS)**

In Session Law 2015-286, the North Carolina General Assembly directed the Department of Environmental Quality to undertake a study of North Carolina’s recycling requirements for discarded computer equipment and televisions. As part of this study, DEACS is asking the local governments that were eligible for state electronics management funds in February 2015 to complete the following survey. Data from this survey will be used to document the cost of operating public electronics recycling programs.

Please fill out the following survey and return it by **Friday, February 5<sup>th</sup>**. Return the survey as an email attachment to [rob.taylor@ncdenr.gov](mailto:rob.taylor@ncdenr.gov). If you have questions or concerns about the survey, please contact Rob Taylor at 919-707-8139 or [rob.taylor@ncdenr.gov](mailto:rob.taylor@ncdenr.gov). Thank you very much for your cooperation!

1. Name of local government and name of individual completing survey:
2. Current electronics recycling vendor:
3. Number of locations currently operated by your government that accept electronics:
4. Does your electronics recycling program partner with other local governments? If so, please describe.
5. Complete the following table itemizing the amount paid to your electronics recycling vendor by category. If unable to itemize expenditures among the categories listed, please indicate the total paid in the bottom row:

Processor Charges	FY 2014-15	FY 2015-16 (YTD)
• Television Recycling Fees		
• Computer Monitor Recycling Fees		
• Transportation		
• Other Charges		
Total Paid to Electronics Recycling Contractor		

6. To your knowledge, does your electronics recycling vendor have a relationship with television or computer equipment manufacturers that enables your vendor to offer your program a subsidized recycling rate?
7. Does your electronics recycling program charge citizens for recycling televisions or other electronics? If so, please provide details of the fees charged to citizens:
8. If your electronics recycling program charges citizens for recycling televisions or electronics, please complete the following table to indicate total revenue earned from those fees:

Fiscal Year	Total Revenue Earned from Electronics Recycling Fees Charged Directly to Program Users
FY 2014-15	
FY 2015-16 (YTD)	

9. If your electronics recycling program has earned revenue from the sale of recycled electronics, please complete the following table to indicate revenues earned.

Fiscal Year	Electronic recycling program revenues from the sale of recycled electronics	Is the revenue listed here deducted from the total expenditure amount listed in question # 5?	
		Yes (please check)	No (please check)
FY 2014-15	\$		
FY 2015-16 (YTD)	\$		

10. Please complete the following table to indicate the amount of money your local government spent to operate your electronics recycling program beyond those expenditures paid directly to your electronics recycling contractor. If you cannot provide exact amounts then please estimate to the best of your ability:

Program Operating Expenses	FY 2014-15	FY 2015-16 (YTD)
• Labor (public employees)		
• Materials and Supplies		
• Other contract costs besides those paid to electronics recycling contractor		
• Maintenance and Repair		
• Other (please describe)		
Total Program Operational Expenses:		

11. Please complete the following tables to indicate the amounts of materials (in tons) collected by your electronics recycling program. Note that there is a separate table for televisions and other types of electronics.

Television Recycling (Tons)	FY 2014-15	FY 2015-16 (YTD)
• Cathode Ray Tube (CRT) Televisions		
• Flat Panel Display (FPD) Televisions		
Total Television Recycling (Tons) Note – if subcategories are not available, please provide total tonnage		

Other Electronic Recycling (Tons)	FY 2014-15	FY 2015-16 (YTD)
• Computer Monitors		
• Covered electronic devices including desktop computers, laptops, tablet computers, printers, scanners or multi-function printer/scanner units		
• Other electronic equipment		
Total Other Electronic Recycling (Tons) Note – if subcategories are not available, please provide total tonnage		

12. Do you have any general comments regarding North Carolina's Electronics Management Program?