Sustainable Materials Management (SMM) Electronics Reuse and Recycling Forum

September 23-24, 2014

Arlington, VA

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Disclaimer:

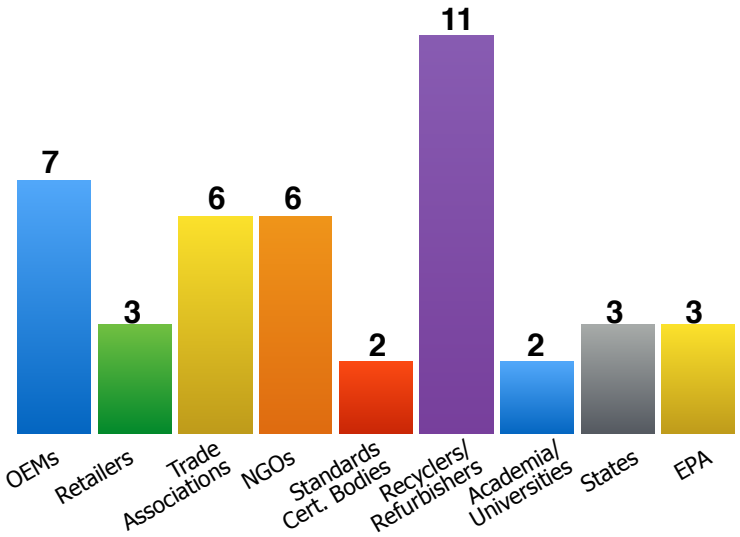
This document summarizes discussions among various parties and is provided for informational purposes only. EPA will consider these comments but is not committing to any course of action. Any mention of product, vendor, or company names or services in this document does not constitute EPA endorsement.

Introduction

On September 23 and 24, 2014, the U.S. Environmental Protection Agency (EPA) hosted a forum to "harness the collective power of the electronics community and identify shared priorities that will advance domestic end-of-life electronics management." More than forty participants took part in this interactive discussion to identify strengths and issues and brainstorm areas of focus to address the challenges of Cathode Ray Tube (CRT) stockpiling and end-of-life electronics management.

Participants of the forum represented a cross-section of the electronics community, including:

- Original Equipment Manufacturers (OEMs)
- Retailers
- Trade Associations
- Non-Governmental Organizations (NGOs)
- Standards Certification Bodies
- Recyclers/Refurbishers
- Academia/Universities
- States
- EPA



EPA had not hosted the electronics community for this type of "problem-solving" forum in over ten years. This was a valuable opportunity to collaborate and network with peers, understand the issues from different perspectives and brainstorm ideas for action.

Appendix 1 contains a list of attendees.

EPA Opening Remarks

The forum began with opening remarks from Lisa Feldt, Acting Deputy Administrator, EPA, and Barnes Johnson, Director, EPA Office of Resource Conservation and Recovery.

Ms. Feldt acknowledged the importance of stakeholder dialogues, such as this Forum, as a means for the electronics community to learn from one another and work collectively to address the safe and sustainable management of used electronics. The last time a similar group was gathered was in 2005. She recognized that this is a pressing issue and identified accomplishments of the past ten years. She encouraged the group that whatever progress was to be made would have to happen collaboratively.

Mr. Johnson reaffirmed the significance of this gathering and walked through a brief timeline of events in end-of-life electronics recycling, which appears on the following page.

Many Changes - Short Span of Time

Consumer Electronics become popular

Localized Event-based **Collection Programs** become Available by Manufacturers and Retailers

Electronics Recycling rate is **19%** nationwide

1990s | **2003** | **2006** | **2009** | **2010**

First **Electronics Recycling Law** Passed in California

CRT Regulation is Finalized and in Force

EPEAT Registry Opens - 60 Computer Products Available

Recycler Certification becomes Available

Electronics Programs Expand and Grow

Twenty-four different **State Electronics Recycling Laws** are in force

SMM Electronics Challenge Launched; There are 1000's of permanent collection points available across the nation.

The number of **Certified Recyclers** reaches **600**; Certified recyclers are found in **44 states** and **17 nations**.

2011 | **2012** | **2013** | **2014**

National Strategy of Electronics Stewardship Released

Electronics Recycling rate for the nation reaches **29%**

EPEAT Registry Expands to Include TV's and Imaging Equipment

There are **1000s** of EPEAT registered products available

2014 SMM Electronics Challenge Awards and Recognition Ceremony

A highlight of the forum was the first annual awards and recognition ceremony for the SMM Electronics Challenge. In 2013, the combined efforts of the SMM Electronics Challenge participants achieved notable environmental results.

By rethinking business as usual and committing to innovative and responsible end-of-life electronics management, Electronics Challenge participants collectively:

- Diverted 221,192 metric tons of end-of-life electronics from the landfill;
- Sent 220,531 metric tons of end-of-life electronics to third-party certified recyclers; and
- Avoided more than 41,000 metric tons of carbon dioxide equivalent in 2013 by increasing certified recycling by 15,588 metric tons, or 7.6 percent since 2012.

This increase is equal to any one of the following:

- Taking over 8,500 passenger vehicles off of the road for one year;
- Saving enough energy to power more than 3,700 U.S. homes for one year; or
- The amount of carbon sequestered annually by more than 33,500 acres of U.S. forest.

The Electronics Challenge offers participants two kinds of awards in recognition of their accomplishments: Tier and Champion. Tier Awards are given to participants in recognition of achieving all of the requirements under a Bronze, Silver or Gold Tier. The Tier requirements are the core of the Electronics Challenge, and participants join at the level that best suits their organization, experience and ability. The second type of awards, the Champion Award, is offered to those companies that go above and beyond the Tier requirements of the Electronics Challenge by demonstrating the highest level of vision, coalition building, and execution of programs and policies related to responsible used electronics management.

The Challenge award winners are listed below. More details are available on the SMM Electronics Challenge Awards page at: http://www.epa.gov/smm/electronics/2014_ec_awrd_wnrs.htm

Company	Award
Best Buy Co., Inc	**Gold Tier Award** **Champion Award, Non-Product Category**
Dell, Inc.	**Gold Tier Award** **Champion Award, Product Category**
Sprint	**Gold Tier Award** **Champion Award, Non-Product Category**
Samsung Electronics, USA	**Gold Tier Award** **Champion Award, Honorable Mention, Non-Product Category**
LG Electronics, USA --	**Gold Tier Award**
Panasonic Corporation of North America	**Gold Tier Award**
Sony Electronics, Inc.	**Bronze Tier Award**
Staples, Inc.	**Gold Tier Award**

Cathode Ray Tube (CRT) Discussion

Problem Statement

The discussion of Cathode Ray Tube (CRT) recycling began with a presentation from EPA on the problem statement, to which participants responded. The refined problem statement and notes from the ensuing conversation are below.

CRT Problem Statement:

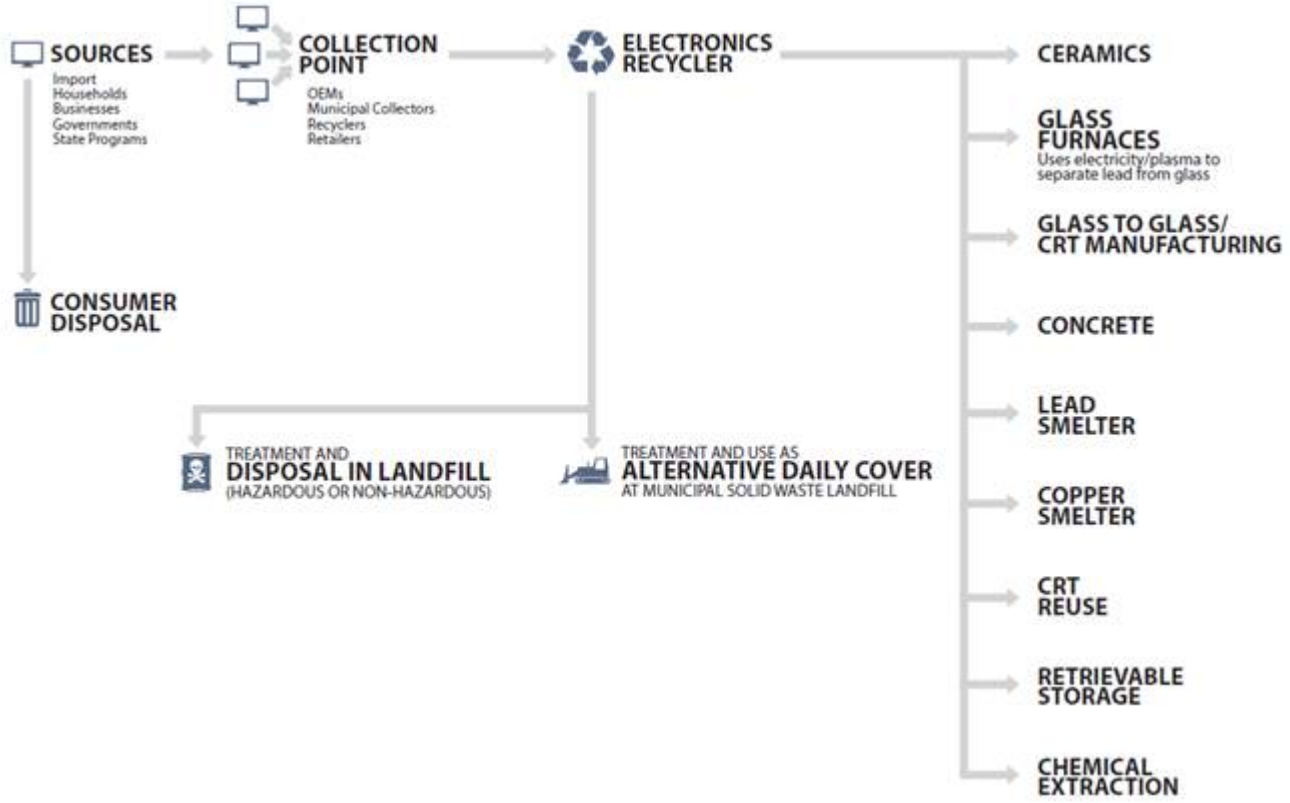
CRTs and CRT glass were once easily recycled into new CRTs; however, the demand for new CRTs has collapsed in favor of new flat panel technologies. Because of rising costs, negative economic incentives, and shifts in CRT glass markets, some CRT processors and recyclers are choosing to store the glass indefinitely rather than send it for recycling (or disposal), which increases the risk of mismanagement and/or abandonment of the CRTs.

Group Discussion on Problem Statement

- There is a financial incentive for entities to get paid to collect CRTs and CRT glass and then not pay to recycle (or dispose)
- We should distinguish between CRTs that are being stored and properly managed versus CRTs that are stored and being poorly managed or CRTs that are abandoned
- There is still a market for CRTs going to reuse
- Phosphors are also an issue with CRT recycling
- There is a significant increase in the number of states who have mandated electronics recycling, while the CRT market has diminished; this means more supply with a decrease in the demand for CRT glass
- This is a short-term issue, as less CRTs will be collected in the future
- Real and perceived liability and risk-management is also contributing to this issue

Factors

In addition to the problem statement, EPA presented the following high-level framework for discussing the CRT issue, to which participants responded. This refined framework, while not a complete picture of the issue, served to guide the discussion.



The conversation was organized into two sections. First, participants discussed the "factors" contributing to the problem in each main element of the framework. Second, participants analyzed the known possible "end uses" for CRT glass, identifying strengths and challenges for each.

SOURCES

Factors Contributing to the Problem

- No legal requirement in many states to recycle electronics
- Inconsistent state laws
- Products with no OEM in existence
- CRTs are big and heavy and inconvenient to recycle
- CRT rule doesn't apply to households
- Consumers may be unwilling to pay to recycle if disposal is cheaper
- Technology change (CRTs replaced by flat panel)
- With EPR laws, responsibility for disposition of CRTs has shifted from consumers to manufacturers (Note: this has different perspectives.)
- Regional variation in collection systems
- "Cherry picking" high-value parts lowers value down the chain
- Economic incentive needed to recycle
- Broken CRTs harder to recycle

- Enforcement needed against illegal disposal by generators

COLLECTION POINT

Factors Contributing to the Problem

- Thousands of collectors are highly fragmented and hard to organize
- No standard or requirements for a "collector"
- Subsidies and manufacturer payments going to collectors rather than recyclers
- Collectors have no solution for CRT glass
- Breakdown in contracting/auditing for ensuring proper CRT glass disposition
- Recyclers collecting without contracts with manufacturers
- "Cherry picking" high-value parts lowers value down the chain
- Lack of/varying levels of education about CRT regulation in different states
- CRTs are heavy and pose a challenge to ship long-distance
- Inconsistency in state programs
- Lack of up-to-date information for consumers on which collectors will take CRTs
- Hiring of recyclers sometimes leads to funding being split by two recyclers
- Lack of rural route density increases cost per unit
- Bad actors in the industry misrepresenting "air pounds"
- Broken CRTs are harder to recycle
- Shipments out of state can't be regulated by original jurisdiction
- Use of pounds as basis for performance encourages CRTs to be collected
- Ergonomic challenges of managing CRTs—physical wear and tear on people

ELECTRONICS RECYCLERS

Factors Contributing to the Problem

- Financial incentive for entities to get paid to receive CRTs and then not pay to recycle (or dispose)
- Lack of enforcement of CRT rule by states and EPA
- Lack of tracking of CRTs to final disposition
- Barriers to entry are low
- Lack of awareness about phosphor, silica and lead hazards in the workplace
- Certification is not assurance of compliance or responsible recycling
- Stewardship organizations represent a monopsony and consolidate the control of contracts by selecting vendors. This creates lack of competition, which in certain states raises costs. (Note: this has different perspectives.)
- Recyclers aren't charging enough to cover costs for recycling
- Too many recyclers are exporting CRTs improperly
- Whenever the state manages CRT recycling, it seems issues of mismanagement increase
- Lack of knowledge about outlets for recycling CRTs
- Lack of engagement of glass manufacturers who made the glass
- Lack of adequate closure plans
- Ergonomic challenges of managing materials—physical wear and tear on people
- Costs are high to switch to new technologies
- Lack of clear specs for recycling grade material
- Need to ship trailer loads of CRTs/glass in order to be accepted

- Thin operating margins, insufficient funds held

End Use Advantages/Challenges

The following are the notes from the discussion of each known "end use" of CRTs—identifying advantages and challenges for each.

End Use	Advantages	Challenges
CERAMICS	• Substitute for raw material • Doesn't require energy to separate lead from glass • Large global capacity potentially available	• Would likely require export • May not be able to export to non-OECD countries • Shifts the lead to ceramics, which may create legacy issue • Proper firing required in order to minimize exposure • Needs regulatory certainty/acceptance • Real capacity unknown
GLASS FURNACES (Uses electricity/plasma to separate lead from glass)	• Smaller and regional in scale; could be co-located with large piles of glass • Multiple furnaces would lower freight costs • Lead recovered from CRT glass	• Very few in operation • High energy consumption; lifecycle assessment may be helpful • Needs longer timeframes to store glass • Small capacity • Permitting/regulatory issues • Disposition of slag
GLASS TO GLASS/CRT MANUFACTURING	• There is niche market for CRTs • CRTs are inexpensive and are more robust equipment for variable power situations	• New CRTs will eventually need recycling • Lack of engagement with the glass manufacturers in recycling options for CRTs • Declining market
CONCRETE	• Huge capacity • Regional markets	• Shifts the lead to concrete products, which may create legacy issue • Whether treatment process adequately prevents leaching • Permitting issues • Potential stigma issues
LEAD/COPPER SMELTER	• Existing process in operation • Regulated • Large capacity (Note: Different perspectives on this point)	• Limited capacity and no growth potential (Note: Different perspectives on this point) • Lead recovery may not be very efficient • Disposition of slag • Air emissions • Variable commodity prices • Permitting of new smelters is difficult • Few smelters in North America accept CRT glass • Perception of taking in hazardous waste • Needs longer term storage of glass
CRT REUSE	• There is niche market for CRTs • CRTs are more robust equipment for variable power situations • Inexpensive compared to LCDs	• Low demand in US • Hard to export; exports can be abused as "sham reuse" • Wiring diagrams are needed to refurbish • Reused CRTs will eventually need recycling
RETRIEVABLE	• Avoids irresponsible speculative	• Funding needed/Need to devise a

End Use	Advantages	Challenges
STORAGE	accumulation • Allows material to be held until solutions appear • Quantify the amount of available feed stock or supply	financial structure to account for recovery • May create a legacy issue • Competes with viable recovery technologies • Hazardous waste permit and regulations may apply • Seen as a "kick the can down the road" approach
CHEMICAL EXTRACTION	• Potentially environmentally friendly process • Complete recovery of lead	• Not operational commercially • Could be expensive • Potentially slow and time intensive • Limited capacity
TREATMENT AND DISPOSAL IN A LANDFILL (HAZARDOUS or NON-HAZAROUS)	• Large capacity likely	• State bans on landfilling CRTs • Doesn't count toward state recycling obligations • Cost • Not environmentally-friendly • Potential stigma issues
TREATMENT AND USE AS ALTERNATIVE DAILY COVER	• Large capacity likely	• Doesn't count toward state recycling obligations • ADC may be considered a form of recycling by some, which discourages other recycling options for CRT glass (Note: Different perspectives on this point) • State approval required for use as ADC • Potential stigma issues

CRT Solutions Brainstorm
Having discussed the issues for CRT management, participants then conducted an initial brainstorm of solutions to be explored in the future. The following solutions were captured during the discussion report-out and on flip charts.

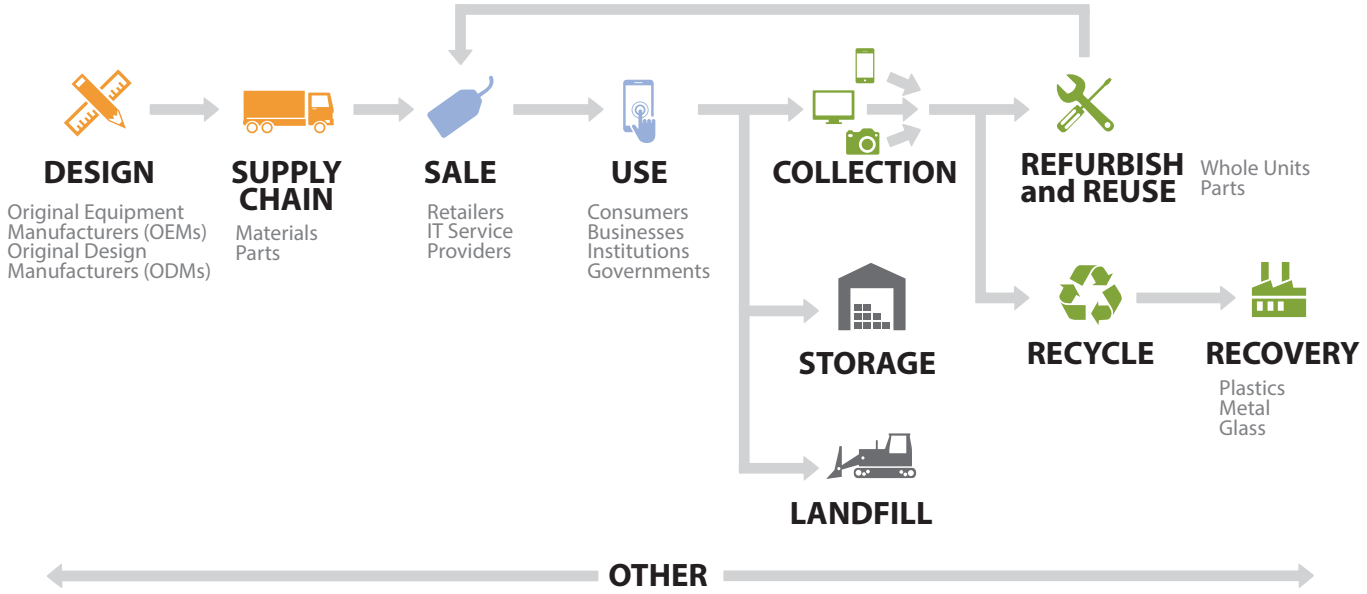
Potential Community Action Areas Generated from Stakeholder Meeting

- Work with R2 and e-Stewards to ensure compliance with the CRT rule, including speculative accumulation, as a means of maintaining certification.
- Improve alignment of financial incentives to facilitate actual recycling, versus collection, of CRTs.
- Consistently and effectively enforce CRT rule and other regulations.
- Provide guidance for those engaging in contracts with electronic recyclers to ensure proper downstream processing of CRT glass.
- Identify available recycling/recovery options and capacity and associated cost.
- Improve awareness of regulations (e.g., training) by states and electronics community.
- Improve tracking of CRTs to ensure proper recycling (or disposal) of glass and to reduce use of "air pounds" to claim manufacturer credits.
- Grant variances, with performance management conditions (e.g., performance management standards, financial assurance, payments to receive set aside for capital investment), for longer-term accumulation of CRT glass by CRT glass processors.
- Conduct/invest in research, development, and lifecycle analyses of technologies to recycle CRT glass.
- Need to coordinate systems-wide approach to the issue.
- Improve consistency in interpretation and application of state law.
- Ensure accountability for mismanaged CRTs.
- Provide incentives for properly managing CRTs and for recycling CRT glass.

Current End-of-Life Landscape

In order to identify actions that are relevant and realistic, it is important to first assess the current state. For this reason, much of the discussion at the end of Day 1 and beginning of Day 2 focused on the current state of end-of-life electronics reuse and recycling.

The following framework was used to guide the current state discussion. Though this framework is not an attempt to fully capture the complexities and nuances of the entire lifecycle, it provided a constructive starting point for discussion. It has been modified slightly, based on comments from participants, but still serves to structure the conversation.



Participants discussed the strengths and issues with each of the three main phases of the lifecycle: **DESIGN and SUPPLY CHAIN**; **SALE and USE**; and **COLLECTION, REFURBISH/REUSE, RECYCLE and RECOVERY**. The notes from this conversation are documented in Appendix 3.

Community Action Areas

Having completed a rigorous discussion of the current state, participants were then able to identify areas for community action. Because addressing all the issues in the overall lifecycle is such a difficult task, it was understood that the most effective approach would be to identify areas where participants in the room had the most interest and energy. These "affinity areas" for community action are listed below, along with clarifying notes under each main area.

A. **Prevent improper management of hazardous materials (e.g., CRTs, mercury bulbs, and batteries) and encourage best management practices.** With new technologies in the marketplaces comes the introduction of new materials that are potentially toxic to human health and the environment. For both new and existing technology it is critical for the electronics community to make strides to improve knowledge of material content and toxicity, enforce existing worker health and safety regulations, and follow best practices to reduce human and environmental exposure to potentially toxic materials. Key actions in this area may include, among others:
   - Improve regulatory enforcement of existing federal and state laws.
   - Establish a dialogue with EPA and States on this issue.
   - Consider new permitting at legitimate facilities for long-term storage.
   - Establish consistent national policy on variances regarding speculative accumulation.

- Develop LCD/copier, etc. rule that would address mercury back lighting in the LCD screen and copier machines (companion to CRT rule).
    - Research can precede rule development if necessary.
- Create best practices to improve education.
- Create a best practices package to assess workplace exposure and plan for prevention.
    - Evaluate existing/new strategies for identifying hazardous materials within devices and components.
- Create best practices for procurement standards that include end-of-life considerations.

B. Improve design for repair, reuse and recycling. Currently, electronics design and end-of-life management are often seen as independent, rather than interrelated, parts of the electronics lifecycle. By encouraging electronics designers to leverage the knowledge and experience of the reuse, repair, and recycling community, we have the opportunity to build a business case for design for repair, reuse and recycling that would optimize the safe and effective use of materials across the electronics lifecycle. Key actions in this area may include, among others:

- Convene designers and recyclers/refurbishers and engage OEMs.
- Allow for efficient access to design information and encourage information-sharing across the value chain (concerning parts, labeling, bill of materials, service manuals, etc.)
- Engage software manufacturers and app stores/developers in a discussion about product design to prolong the life of electronics.
- Brand a program for recognizing design for recycling/disassembly (similar to Energy Star).
- Create best practices for procurement standards that include end-of-life considerations.
- Create new incentives for manufacturers to support a reuse, repair and recycling.
    - Consider this as an alternative approach to Extended Producer Responsibility (EPR).

C. Identify best practices for verifying and selecting recyclers and refurbishers that adhere to responsible end-of-life electronics management processes. Recyclers and refurbishers who do not adhere to existing laws risk undercutting those that follow laws and that may be certified to one or more third-party certified recycling standard. By encouraging accountability and enforcement of existing regulations, we can level the playing field and provide incentives for the use of responsible electronics recyclers and refurbishers. Key actions in this area may include, among others:

- Create a standardized mass balance/tracking system and method for confirming receipt of end-of-life electronics equipment.
- Create sample procurement language for obtaining responsible recycling services.
- Compile materials use information.
- Establish quality assessment of certifications.

D. Research is needed to obtain a quantifiable understanding of issues surrounding electronics recycling.

- Marketing and commercial issues
- Technical issues such as potential exposure experienced in recycling facilities.
- Behavior issues such as drivers for recycling

E. EPA could use its convener role to engage stakeholders on various electronics issues.

- Encourage harmonization of laws (e.g., take back laws).
- Engage retailers on electronics collection and recycling.
- Develop website/document of best practices (benchmarking, state-to-state, etc.).

F. Determine EPA's role and involvement in new laws and policies.

- Data security and locking laws [known as "kill switch"] laws designed to prevent cellphone theft Second-hand dealer laws
-

G. Increase the effectiveness of the electronics recycling system at recovering valuable resources.

- Identify how to recycle future critical materials that will need to be recycled and that aren't currently.
- Increase the usage intensity prior to recycling (e.g., more reuse, more repair and longer product use)

H. Perform a comprehensive inventory of laws and regulations relating to electronics reuse and recycling to create tools and training to aid in compliance and enforcement.

- Create tools and training to aid in compliance and enforcement

I. **Perform an inventory of best practices for innovative business models that encourage sustainable reuse and recycling.**
   - Capture financial benefits/business case
   - Look at the consumer products sector for examples.

J. **Develop a web portal related to used electronics management.**
   - Develop online, ongoing communication system (similar to EPA's Job Through Recycling (JTR) initiative.

Top Community Action Area Details

After the initial brainstorm of community action areas, participants voted on the areas they were most interested in, considering which would provide positive change across the lifecycle and which had the highest probability of action. The results of the vote are documented in Appendix 4.

Three areas emerged as the top areas for discussion. Participants then looked at these three areas in more detail, identifying ideas about **how** the issue could be addressed and **who** should be involved. The following are the notes from this discussion.

Area A: **Prevent improper management of hazardous materials and encourage best management practices.**

How to Address the Issue

- Create best practices to improve education.
- Improve regulatory enforcement of existing federal and state laws.
- Establish a dialogue with EPA and States on this issue.
- Establish new permitting at legitimate facilities for long-term storage.
- Develop LCD/copier, etc. rule that would address mercury back lighting in the LCD screen and copier machines (companion to CRT rule).
  - Research can precede rule development if necessary.
- Create a best practices package to assess workplace exposure and provide a plan for prevention.
  - Provide guidance concerning lead/mercury and other hazardous materials.
  - Evaluate existing/new strategies for identifying hazardous materials within devices and components.

- Compose an interpretation letter of how existing rules related to mercury lamps apply to this industry.
- Create a Center of Expertise (incorporating project management)
    - Create a white paper to define these issues.
- Leverage studies by National Institute for Occupational Safety and Health (NIOSH) on dangers of mercury and other hazards.
- Create a consistent national policy on when to grant variances on speculative accumulation, and under what conditions.
- Create education program on hazardous materials for state agencies, especially about CRTs.
- Gather existing industrial hygiene monitoring from existing LCD teardown operations.
- Convene state enforcement officials to develop best practices for identifying stockpiling issues.
    - Engage federal enforcement officials.
    - Enforce existing laws and regulation.

Who Should Be Involved

Federal
- Occupational Safety and Health Administration (OSHA))
- National Institute for Occupational Safety and Health (NIOSH)
- US EPA
- National Enforcement Investigation Center (EPA)
- National Safety Council

State
- State enforcement officials
- Environmental health and safety professionals
- Certification programs

Associations and NGOs
- North American Hazardous Materials Management Association (NAHMMA)
- Clean Production Actions group
- Environmental NGOs
- International Electronics Manufacturing Initiative (iNEMI)
- Institute of Electrical and Electronics Engineers (IEEE)
- CHWMEG

Other
- Expertise on new materials being used and hazards (TBD)
- Original Equipment Manufacturers (OEMs)
- Recyclers
- Refurbishers
- Occupational Medical people, Industrial Hygienists and MDs

Area B: Improve design for repair, reuse and recycling.

How to Address the Issue

- Create a best practices package for design for reuse/recycling to feed into procurement standards.
    - Conduct face-to-face workshops.
- Improve information-sharing across the value chain (concerning parts, labeling, bill of materials, service manuals, etc.).
- Engage software manufacturers and app stores/developers concerning design.
- Brand a program for recognizing design for recycling/disassembly (similar to/within Energy Star).
- Incentivize manufacturers to support a reuse ecosystem and design for recycling/disassembly.
    - Consider as an alternative approach to Extended Producer Responsibility.
- Create a Center of Expertise.
- Enable efficient access to design information gleaned from OEMs on how to disassemble products and identify toxins.
    - E.g., Create a central database that would house:
        - Disassembly procedures for recyclers
        - Repair manuals for repairers
    - Explore social media tools
- Develop metrics on the reparability/durability of products.
- Develop a strategy for removing toxins from products.
- Screen new materials for toxicity concerns.
- Develop strategies for extending battery life and/or replacing batteries.
- Establish objective rating criteria/standard for products.
- Incorporate design for repair, reuse and recycling concepts into CAD software.
- Create a feedback loop between the recycle/refurbish/reuse community and design community during the design process.
    - E.g., Survey Monkey
    - Develop a tool to assess economic recyclability of products.
- Explore an open approach to design that allows for unintended future uses (e.g., repurposing/upcycling).
- Raise awareness in the design community.
    - E.g., Bring designers to the recycling facility.
- Compile information that's useful for materials choices for designers (e.g., EPA could do this).
- Address how to get parts in the repair ecosystem.

Who Should Be Involved

Industry

- Original Equipment Manufacturers (Product Designers, Managers, Warranties, Repairs/Returns, Packaging)
- Original Design Manufacturers (ODMs)
- Recyclers
- Refurbishers
- Repairers, including individual repair shops and iFixit
- Parts providers/component manufacturers (e.g., AbNet, Arrow Electronics, Inc., Corning, Foxconn)
- Software manufacturers
- App stores (Amazon, Apple, Google, etc.)
- Major design groups (especially IDEO, frog, Lunar)
- Purchasers
- Autodesk (CAD)

Federal

- US EPA

Associations and NGOs

- Standards organizations
- Universities (Mechanical Engineering and Design)
- Digital Right to Repair Association
- Environmental NGOs
- Electronic Frontier Foundation
- Public Knowledge
- IEC TC111 (Re: 62474 Standard)
- Partners for Award/Recognition (e.g. ITI, ISRI, CEA, GEC, iFixit)
- IEEE 1874

Area C: Identify best practices for verifying and selecting recyclers and refurbishers that adhere to responsible end-of-life electronics management processes.

How to Address the Issue

- Create a standardized mass balance/tracking system and method for confirming receipt of end-of-life electronics equipment.
    - There is a need for consistency in the mass balance approach.
- Create sample procurement language for obtaining responsible recycling services. Solicit/synthesize existing contract language for contracting product take-back and recycling services—from private companies and the federal government.
- Establish a quality assessment of certifications
    - Tracking multi-year trends by facility.
    - Provide both environmental and worker health and safety best practices for recycling and handling specific products such as CRT glass, batteries, and mercury containing devices.
    - Include more descriptive/prescriptive language around closure plans.
    - Include accessible and sufficient financial assurance in the closure plans.
    - Ensure consistency across all actors in the certification process.
    - Provide better training for auditors regarding state laws (e.g. what is/is not allowed).
    - Focus on quality of facilities, not quantity.
- Create a clearinghouse for recycler documentation (e.g., certification, insurance information, and downstream vendors).
- List refurbishers who are doing the licensing properly.
- Create a "ready for reuse quality" website.
- Communicate with consumers, so they know which recyclers to use.
- Increase accountability to mitigate against recyclers who are not meeting standards.
    - Ask recyclers: Why are you doing this? Who are you doing it for?
    - Require CEO's signature on transactions.
    - Make sure there are funding mechanisms in place.

Who Should Be Involved

Federal

- US EPA
- National Center for Environmental Research (NCER)
- U.S. General Services Administration (GSA)
- Federal Electronic Stewardship Working Group (FESWG)

Industry

- Microsoft
- Original Equipment Manufacturers
- Refurbishers
- Recyclers
- Purchasers

Associations and NGOs

- Certification Programs
- Environmental NGOs
- Institute of Scrap Recycling Industries (ISRI)
- State Programs
- Compliance Schemes (e.g. MRM)
- Arizona State University (re: tracking)
- Non-Profit/Charity Collectors (e.g. Goodwill, etc.)
- International Association of IT Asset Managers (IAITAM)
- International WEEE organization
- Associations of Surplus Property Managers (State and other)
- Project Management Institute (for project management discipline, incorporated into all three areas)

Other Sector Examples

- Lawyers
- Auditors

Closing

EPA Closing Remarks

Barnes Johnson, Director, EPA Office of Resource Conservation and Recovery, shared his closing thoughts to the Forum. He acknowledged the desire to have meetings like this, with diverse stakeholder groups, more frequently than once a decade. He reminded participants that these conversations will continue, beginning with EPA-facilitated sessions at the E-Scrap conference in October, 2014. He also remarked on how having EPA's Acting Deputy Administrator in attendance at the Forum signals the importance to EPA of improving end-of-life electronics recycling management.

Participant Reflections

In closing, participants were asked to give a short response to the question: "How are you feeling about what you accomplished leaving the Forum today?" Responses are captured below.

- Pleasantly surprised
- Thorough
- Thank you; maybe have these more than once every 14 years?
- Good brainstorming
- Well organized, conceptually
- Well-facilitated
- Reaffirmed my view that this group of people has a common vision; heading in the right direction
- A lot of alignment of common interests
- Civil and cooperative
- Substantive
- We need to communicate this to a wider audience: who, what, why, how, etc.
- Nice to see so many EPA representatives here
- Learning through listening
- Amazing thoughts

APPENDIX

1. Meeting Participants

Organization	Last	First	Email
Consumer Electronics Association (CEA)	Alcorn	Walter	walcorn@ce.org
Sprint	Beck	Darren	darren.d.beck@sprint.com
Closed Loop	Benham	Brent	bbenham@clrrusa.com
Novatec	Bolon	Tom	
HOBI	Boswell	Craig	cboswell@hobi.com
Pennsylvania Recycling Markets Center	Bylone	Bob	rjb128@psu.edu
PC Builders and Recyclers	Cade	Willie	willie@pcrr.com
Association of State and Territorial Solid Waste Management Officials (ASTSWMO)	Callahan	Kerry	kerryc@astswmo.org
LG Electronics USA, Inc. (Awards)	Cho	Jacob	
Best Buy Co., Inc.	Dunn	Tim	
Association of State and Territorial Solid Waste Management Officials (ASTSWMO)	Forbeck	Mike	mforbeck@pa.gov
Information Technology Industry Council (ITI)	Goss	Rick	rgoss@ITIC.org
Nulife	Greer	Simon	simon@nulifeglass.com
Minnesota	Hickle	Garth	garth.hickle@state.mn.us
Pennsylvania Recycling Markets Center	Himes	Jack	jlh587@psu.edu
Institute of Scrap Recycling Industries (ISRI)	Horne	Scott	ScottHorne@isri.org
Dell Inc.	Johnson	Beth	elizabeth_johnson@dell.com
US EPA Office of Resource Conservation and Recovery	Johnson	Barnes	Johnson.Barnes@epa.gov
LG Electronics USA, Inc.	Kang	Jane	Jane.kang@lge.com
Green-eyed Partners	Keogh	Kelley	kelley@greeneyepartners.com
Sims Recycling Solutions	King	Larry	Larry.King@simsmm.com
US EPA Office of Resource Conservation and Recovery	Kohler	Amanda	Kohler.Amanda@epa.gov
Electronics TakeBack Coalition (ETBC)	Kyle	Barbara	bkyle@etakeback.org
Regency Technologies	Levine	Jim	jimlevine@regencytechnologies.com
SERI (R2)	Lingelbach	John	lingelbach@r2solutions.org
National Center for Environmental Research (NCER)	Linnell	Jason	jlinnell@electronicsrecycling.org
Total Reclaim	Lorch	Craig	clorch@totalreclaim.com
The Sustainability Consortium	Mars	Carole	carole.mars@asu.edu
Maryland	Masood	Tariq	tariq.masood@maryland.gov
Samsung Electronics	Moss	Mike	mikem@sea.samsung.com
US EPA Office of Resource Conservation and Recovery	Naples	Eileen	Naples.eileen@epa.gov
Universal Recycling Technologies	Orlowski	Paul	POrlowski@universalrecyclers.com
Cascade Asset Management	Peters	Neil	nmichaud@cascade-assets.com
US EPA Office of Resource Conservation and	Pollard	Karen	Pollard.Karen@epa.gov

Organization	Last	First	Email
Recovery			
E-Scrap	Powell	Jerry	jpowell@resource-recycling.com
e-Stewards	Puckett	Jim	jpuckett@ban.org
US EPA Office of Resource Conservation and Recovery	Resek	Liz	Resek.Elizabeth@epa.gov
Green Electronics Council	Rifer	Wayne	WRifer@greenelectronicscouncil.org
Association of State and Territorial Solid Waste Management Officials (ASTSWMO)	Rodriguez	Dania	daniar@astswmo.org
Transparent Planet	Roman	Lauren	lroman@transparentplanetllc.com
State Electronics Challenge	Rubenstein	Lynn	lynn@nerc.org
Dell Inc. (Awards)	Sanders	Deborah	
Sony Electronics Inc.	Smith	Doug	douglas.smith@am.sony.com
Kuusakoski	Takala	Anssi	anssi.takala@kuusakoski.us
Panasonic Corporation of North America	Thompson	David	thompsond@us.panasonic.com
Electronic Recyclers International	Watson	Mike	Mike.watson@electronicrecyclers.com
Best Buy Co., Inc.	Weislow	Scott	scott.weislow@bestbuy.com
iFixit	Wiens	Kyle	kyle@ifixit.com

2. Ingredients Critical for Success

Upon reflecting on the accomplishments in electronics reuse and recycling to date, participants brainstormed the key "ingredients"—i.e., community characteristics—that were essential for these accomplishments in the past. The purpose was to identify anything that needs to be recreated for future efforts to be successful. Below are the ingredients captured:

Market Incentives

- Development of secondary market
- Viable recycling markets
- Business opportunities for recyclers/refurbishers
- Entrepreneurial ingenuity and risk-taking in the private sector
- Healthy manufacturing sector
    - Supply of materials

Stakeholder Participation/Alignment

- Having a shared agreement of "success"
- Awareness of all of the issues
- Having a broad representation in the industry
- Cooperation among parties (OEMs/recyclers, etc.)
- Publicly stated goals to drive accountability

Regulations/Policies

- Regulatory interest and pressure
- Clarity about the contents of the regulations and enforcement
- National/global product policies, including from private sector
- Certification
    - Adoption
    - Integrity

Drivers/Motivators

- Maintaining company reputation / being exposed / PR risk
- Rigorous academic review and research

Consumer Engagement

- Considering what the consumer wants
- Market-based incentives for consumers
- Increased public awareness and recognition of the need to recycle
- Increase in collection opportunities for consumers

Tools

- Information-sharing on the internet
- Improved or new/emerging technologies that lead to process innovation
- Integration of design through recycling

3. Current State of Electronics End-of-Life Landscape

Participants discussed the **strengths** and **issues** with each major phase of the end-of-life recycling landscape.

SUPPLY CHAIN and DESIGN

Strengths

- Some manufacturers are making progress in reducing toxic materials in products and process—due to innovation and advances in technology.
- There is excellent design for the Use and Sale phase, but design considerations don't go further down the supply chain (to the Collection, Refurbish/Reuse, Recycle and Recovery phase).
- Dematerialization of products; there is less material going into products.
- Consumer needs are being met in an efficient/affordable way; there is a large volume of products flowing through the system.
- Design is increasingly innovative.
- There are pockets of examples where designers *are* designing for recycling.
    - When this works, there is a very high return on investment, but this fact is not widely understood.

Issues

- Due to the international nature of the supply chain, parts availability and validation of legitimate reuse is limited.
- The presence of counterfeit items in the supply chain has a downstream impact on recycling/reuse/recovery.
- There are not enough controls over small manufacturers (parts makers), so toxic materials may be incorporated into the products.
    - The process itself also may release toxic materials.
- New technologies are bringing new materials (e.g. nano materials) that may have an unknown downstream effect.
- There is a general lack of information about the material contents of products coming down the supply chain.
- There is the potential for diminished demand for recycled products in the supply chain.
- There are trends towards non-repairability/replaceability/reprogrammability in the design of products.
- Intellectual property rights—both physical and software-related—create constraints.
    - E.g., there is no path for recyclers to unlock/remove the "kill switch" for devices with this feature.
- Economic recyclability of products is an issue: the costs exceed what can be earned through recycling.
- The historical focus on OEMs to bear the cost is not sustainable over the long-term.
    - Note: Consumers and others (e.g. taxpayers) also bear this cost.
- Designers aren't designing to solve the recycling problem.
    - There needs to be a business case for this.
    - States need to promote this level of engagement.
- There isn't buy-in to the problem from all parts of the supply chain, including consumers.

SALE and USE

Strengths

- Retailers have the connection/ability to talk to consumers; this is the strongest point of connection.
- Retailers can serve as an influencer on the market.
- Selling products as a service creates a captive audience and helps manufacturers get the product back.
    - E.g., Set top box providers.
- Retailers are a natural collection point from, a consumer perspective.

    - This can also be good for the retailer because it gets customers back in the store.
- Retailers are subject to sales bans under state laws, which is an effective tool to get manufacturers to comply with the law.

Issues

- Understanding consumer demand/behavior is difficult and essential for getting other initiatives off the ground; barriers aren't well understood.
    - Retailers who design for recycling aren't necessarily rewarded by the market.
- The "Sale" end of the market is changing rapidly; this makes it difficult to target where to be in the future.
- There is a stigma that "green products" don't work as well; this needs to be overcome.
- There is a need for additional strong retailers to assist with collection.
- There is no specific fee on the product to go toward recycling.
- There is a perception that recycling *should* be free.
- There is a need to keep track of all manufacturers, to hold them accountable to state law.
- There are legal barriers to providing incentives for recycling or buy-back (second-hand dealer laws).
- Retailers have the opportunity to get more engaged in the effort.
- Retailers should provide more information to consumers about the environmental impacts of purchase decisions.
- Retailers should seek consistency in how they contract with recyclers.
- Retailers should aim for consistency between the buyers' understanding/action and a company's sustainability policies.

COLLECTION, REFURBISH and REUSE, RECYCLE, and RECOVERY

Strengths

- In some instances, communities are effective at collecting material.
- There are many different types of collectors and collection locations.
- Good manufacturers are doing their own audits of recyclers to identify those who are not complying—rather than relying on certifications.
- Collecting small devices is relatively easy.
- Refurbishing/demanufacturing/pre-processing has very elastic capacity.
- GSA's existing due diligence system for contractors is very thorough and could be leveraged.

Issues

- There is a lack of harmonization between state programs.
- Local collection activity faces challenges; often it's not clear what to do with the material once it's been collected
- Material collected is very diverse; high volumes are required to realize value.
- There is price volatility of commodities.
    - Note: There was discussion that many of these issues are normal business pressures and are the responsibility of business owners to address.
- There is a general lack of accountability in this phase.
- There is a need for enforcement of laws.
- Electronics recycling requires more education, research and effort on the part of consumers than traditional recycling.
    - Effective efforts are being made to engage consumers within 10 states.
- There is a need for better balance of convenience for collectors and efficiency of collection.
- There is scavenging from collection sites; not all valuable material makes it to the recycler.
- State regulations don't require manufacturer to be responsible for their own product type.
    - There is concern for who takes ownership of other product types (e.g., CRTs).

    - There is an inconsistent/imperfect relationship between the weights of products being sold and products being recycled.
- There is a lack of understanding of the factors that produce the best recovery rate.
- The storage period after the Use stage means that often materials are old and may be less valuable by the time they get recycled.
- There is a need for a broad consumer education/communications campaign, especially for smaller products (tablets etc.).
- There is a need for workable second-hand dealer laws (for state and local governments).
- There are recyclers who are not behaving responsibly (stockpiling, ghost pounds, etc.) This behavior risks putting responsible recyclers out of business.
    - There is a temptation to go with lowest price recyclers; there is no way to clearly identify the responsible recyclers and legitimate markets/prices.
    - This is a role for enforcement officials and certification officers to play.
    - There is a lot of confusion about what constitutes a legitimate recycler and how to measure and track this.
    - It is unclear what EPA and states can do to address this issue.
- Some state laws put up barriers to reuse.
- Many states have no laws that can be enforced.
- Sensitive data, especially on smaller products, is a consumer concern.
- There is a need for a tracking system to see where materials go.
    - How to accurately track is very difficult; this affects certification and enforcement.
- Having so many certified recyclers creates a false sense of security.
    - Audits could reduce the risk.
- Rules and regulations often have unintended consequences.
    - This community needs a voice.
    - E.g., Activation locks ("kill switches") threaten the value of resale.
    - E.g., Collectors bear the cost/burden of dealing with metal theft.
- There are health and safety concerns with recycling re: toxic materials.
- Flat screens with mercury bulbs potentially pose a future issue similar to CRTs.
    - There are inadequate warnings/information about this issue.
- Precious metals and other valuable materials have low recovery rates.
    - There is a role for EPA to convene parties to address these issues.
    - Collection is the major part of this, but losses occur across the system.
- Reuse is an integral piece in the overall recycling value chain.
- Many state laws don't reflect the economics of the "compliance market" (vs. free market) and have difficulty adapting to changes in products and markets.
- There is an increase in demand for information from stakeholders, especially:
    - Manufacturers needing information about environmentally sensitive materials.
    - Reuse/recyclers needing information for disassembly.
        - There is a lack of information for recyclers to aid with manual disassembly, which could make recycling easier and more profitable.
        - There is currently no system to make it available.
        - There is currently no central database.
    - Recovery of rare earth materials.

OTHER (Cross-Cutting)

Issues

- There are not enough economic incentives to get the pieces in place to address system-wide issues.
- There are challenges with quantifying the problems.

4. Affinity Area Rankings

Affinity Area	VOTES
A. Prevent improper management of hazardous materials and encourage best management practices.	**29**
B. Improve design for repair, reuse and recycling	**27**
C. Identify best practices for verifying and selecting recyclers and refurbishers that adhere to responsible end-of-life electronics management processes	**16**
D. Research is needed to obtain a quantifiable understanding of issues surrounding electronics recycling	**12**
E. EPA could use its convener role to engage stakeholders on various electronics issues.	**11**
F. Determine EPA's role and involvement in new laws and policies.	**9**
G. Increase the effectiveness of the electronics recycling system at recovering valuable resources	**7**
H. Perform a comprehensive inventory of laws and regulations relating to electronics reuse and recycling to create tools and training to aid in compliance and enforcement.	**6**
I. Perform an inventory of best practices for innovative business models that encourage sustainable reuse and recycling	**1**
J. Develop a web portal related to used electronics management	**1**

5. Ideas for Near Term Actions

At the conclusion of the Forum, participants were asked to write down any ideas about "near-term actions" that could be accomplished in any of the areas discussed. Below are the ideas participants submitted, in their words.

Category	Comment
Convene Stakeholders	Host/organize convene meeting/facilitated discussion of OEM designers and recyclers
	Organize/convene meeting of industry stakeholders
	Organize/convene meeting of EPA and states to review program successes and highlights
CRT	EPA should permit long term storage of CRT glass, with conditions, at glass furnace facilities and possibly other processes that qualify
	Convene meeting of EPA and state enforcement officials to discuss CRT rule enforcement best practices. Include guidance on: • How to detect stockpiling • Conditions for issuing variances
	Make CRTs a Universal Waste
	Cut a my data set on hard drive storage times to hypothesize the effect of size on storage time
	Educate state agencies on CRT rule and problems
	Create policies to make speculative accumulation variances more rigorous
	CRT education to the states
	Enforce existing laws/rules on CRTs
	Variance for legitimate stockpiling of cleaned and sorted CRT glass. The US does have capacity to separate and clean all CRTs generated. Once in this form, a performance based protocol for stockpiling should enable safe long-term storage.
	Use EPA technical knowledge and industry's business knowledge to find a way to quickly deal with the CRT funnel glass situation. This issue is distracting many people from focusing on the broader spectrum.

Category	Comment
Design	Design for Recycling
EPA Actions	EPA Office of Resource Conservation and Recovery should identify what happened to last set of computers they replaced in their office – it will be a good educational awareness exercise
	EPA promote (or continue to encourage) the use of certified recyclers that are on the GSA schedule (as a means to demonstrate adequate responsibility and due diligence and facilitate the contracting process for federal agencies and their IT contractors to use for the refurbishing and recycling of their assets
Information Sharing/Communications	Ask manufacturers about existence of service manuals and the current status of information exchange with independent repairers and recyclers
	Finalize creation of supply chain mapping diagram
	Authorship/research/creation of an EPA guidance document on collection system best management practices.
	"Develop online ongoing communication system" is pretty easy (although no interest)
	Create an industry glossary of terms. Purpose: to further a common understanding and facilitate progress
Laws/Regulations	Work to stop any kill switch/lock laws
	Perform comprehensive inventory of laws
	Engage with other agencies to influence/end kill switch legislation and other anti-reuse regulations/laws
	Participating in the "kill switch" discussion and issuing a position on the potential environmental impact.
	Provide input to the copyright office on cell phone and other device unlocking. Process starts now – November 5th.
	Change kill switch laws that prevent reuse
	Kill switch laws that need action – EPA needs to be vocal to other agencies, such as FCC and Justice to slow down adoption of "kill switch" or "locking laws" that eliminate reuse of cell phones
	Comprehensive inventory of laws and regulations through possibly third party expert (consultant)
	Enforcement. Enforcement. Enforcement. There is no excuse that current laws are simply not being enforced This would put an end to bad practices in very short order and eliminate many of the bottom-feeders who are damaging responsible e-recycling businesses and the health of the industry as a whole.
Select & Verify "Good" Recyclers/Refurbishers	Assist in creation of National Tracking System
	Sample model contract/procurement templates
	List of certified recyclers with capabilities
	Quality review of certification programs

6. List of Acronyms

ADC	Alternative Daily Cover
CEA	Consumer Electronics Association
CRT	Cathode Ray Tube
EPA	US Environmental Protection Agency
EPR	Extended Producer Responsibility
FESWG	Federal Electronic Stewardship Working Group
GSA	General Services Administration
IAITAM	International Association of IT Asset Managers
IEEE	Institute of Electrical and Electronics Engineers
iNEMI	International Electronics Manufacturing Initiative
ISRI	Institute of Scrap Recycling Industries Inc
JTR	Job Through Recyling
LCA	Lifecycle assessment
LCD	Liquid-crystal display
NAHMMA	North American Hazardous Materials Management Association
NCER	National Center for Electronics Recycling
NGO	Non-governmental organization
NIOSH	National Institute for Occupational Safety and Health
ODM	Original Design Manufacturer
OECD	Organisation for Economic Co-operation and Development
OEM	Original Equipment Manufacturer
ORCR	Office of Resource Conservation and Recovery
OSHA	Occupational Safety and Health Administration
SMM	Sustainable Materials Management
US ITC	United States International Trade Commission