Sourcing Critical Materials via Recovery

Critical Materials Institute
Annual Meeting
August 16, 2016

Wayne Rifer
Green Electronics Council

What is EPEAT?

- The Electronic Product Environmental Assessment Tool
- The EPEAT Registry - A free and trusted source of environmental product ratings for electronics
- A tool that catalyzes environmental leadership by leveraging market demand for sustainable electronics
- A system available in 43 countries that sets a common bar for environmental performance based on voluntary consensus standards

What is the Green Electronics Council?

The Green Electronics Council (GEC) seeks to achieve a world in which only sustainable electronics are designed, manufactured, bought, used and recycled.

To achieve a sustainable electronics world, GEC collaborates with stakeholders of all types to facilitate the adoption of sustainable manufacturing and procurement behaviors.

GEC Mode of Operation

GEC advocates for sustainable electronics by facilitating both manufacturers and large-scale purchasers to:

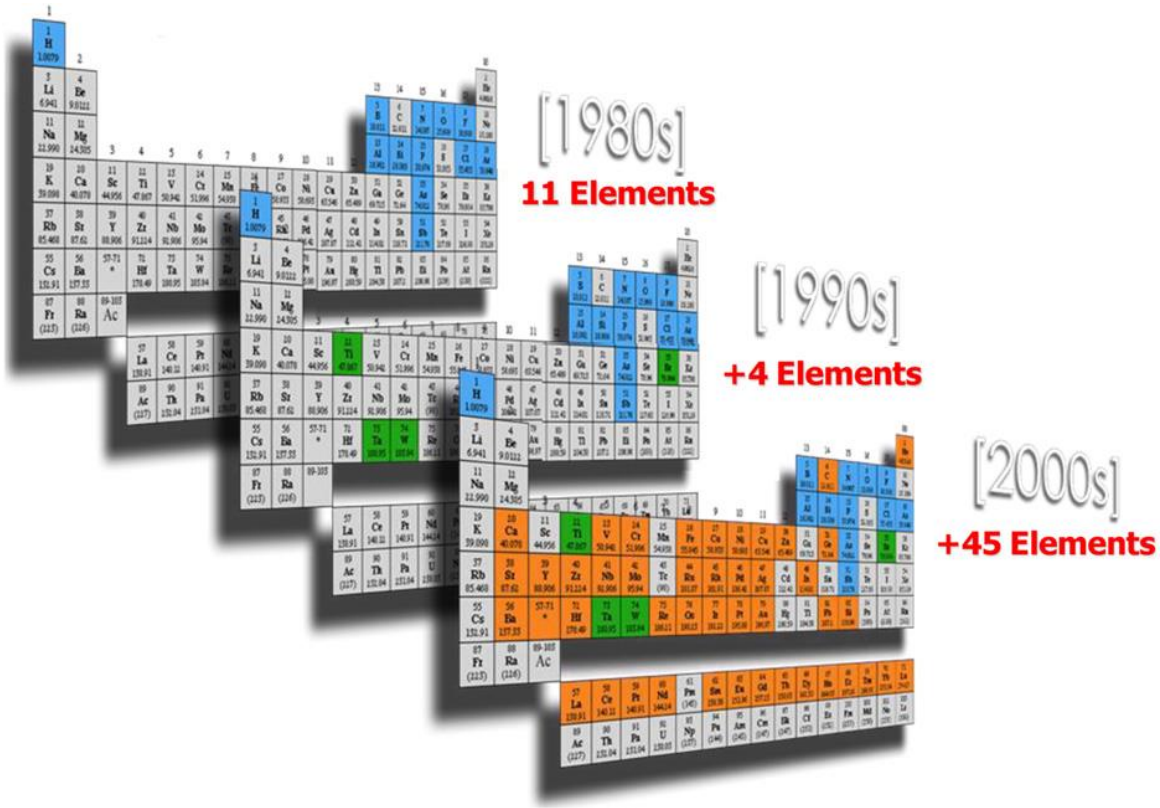
- **Understand** the challenges facing sustainable electronics
- **Commit** to address those challenges
- **Act** and change internal operational, manufacturing and procurement behaviors

Situation Analysis for CM Recovery

- Challenges of EoL electronics system
  - Severely challenging economics
  - Volatile (depressed) commodity prices
  - High labor costs
  - Highly dispersed sources, handled by independent parties
  - Predominance of mass processing in response to consumer technologies
  - Small CM quantities per product, great numbers of products
- The trend to miniaturization, product dematerialization, and the introduction of new heterogeneous materials systems create new challenges
- Small CM quantities per product, though a great number of products

Situation Analysis for CM Recovery

- Initial processing systems are under-optimized for recovery of “lesser” metals
  - Based largely on processing developed for historical products, e.g. mass shredding
  - Focus is on the bulk materials
  - Program success is measured in lbs. recycled



Situation Analysis for CM Recovery

- Even the most precious metals are recovered at low rates
  - Losses occur at collection, pre- and final-processing

Recycling Rates of Metals	
Element	**Electronics Sector Recovery Rate**
Ru	0 to 5
Rh	5 to 10
Pd	5 to 10
Ag	10 to 15
Ir	0
Pt	0 to 5
Au	10 to 15
UNEP International Resources Panel, 2011	

- Environmental perversities can stimulate policy change

Relative Environmental Values of Some Materials in Electronics		
Material	**Environmental Value***	**Relative Environmental Value**
Gold	13,800.00	60,526.3
Palladium	10,100.00	44,298.2
Silver	47.40	207.9
Aluminum	0.78	3.4
Polyethelene	0.28	1.2
Steel	0.23	1.0
Glass	0.10	0.4
*QWERTY scores, Jaco Huisman, "The QWERTY/EE Concept", Dissertation, Delft U., 2003		

Opportunities to Increase CM Recovery

- The challenge addressed here is how to develop reliable delivery of the quantities of raw CM-containing materials, at spec, needed for cost-effective final processing
- Key is a financially sustainable pre-processing infrastructure, operating within a coordinated system, to:
  - Capture and consolidate,
  - Pre-process to specs required by final processing technologies, and
  - Transport them to the final processor of choice.
- To effect recovery of CMs, the recycling infrastructure must yield value from multiple sources
  - Critical materials will not pay the bills (like all outputs taken individually)
  - But they can contribute a small share
  - Thus their recovery must be part of a system designed for multiple revenue streams

Opportunities to Increase CM Recovery

- Both a system's challenge, and a policy challenge.
- The systems challenge: CM recovery demands sophisticated pre-processing and aggregation,
  - Targeted component and material liberation
  - Manual/mechanical disassembly
  - New processing technologies – e.g. robotics
- But by themselves CMs cannot pay
- How can the financial woes of the e-recycling infrastructure be addressed such that CM recovery is a part of the solution?
- Needed: a roadmap for optimal recovery
  - Requirements at each stage of the EoL chain
  - Roles of actors

Opportunities to Increase CM Recovery

- Recycling is a policy-rich (policy-driven) arena
  - Most recycling occurs due to, and is supported by, policy implementation
    - Direct funding
    - Regulatory requirements
    - Purchasing and disposition specifications
    - Voluntary consensus standards
- Here we have a confluence of two policy agendas – Circular Economy and Security
- These policies can play a role in actualizing recovery that includes CMs

Opportunities to Increase CM Recovery

- Potential policy instruments:
  - Institutional (governmental) procurement policy
    - The backbone of EPEAT which has driven increased recovery
      - Through standard requirements upon which the EPEAT Registry is based
      - EPEAT standard initiatives:
        - Recycled content
        - Design for reuse/recycling
        - Information exchange between manufacturers and reuse/recycling organizations
    - Procurement specifications
  - Recycler standards
    - E.G. R2, e-Stewards, WEEELABEX treatment standard, EN 50625 Collection, logistics and treatment requirements for WEEE
    - Traditionally have addressed primarily EH&S
    - Some discussions considering addressing also recovery best practices
  - Governmental requirements
    - State take back programs
    - Surplus equipment management

Opportunities to Increase CM Recovery

- Evolving technologies are enhancing reuse as an opportunity
  - Repair, refurbishment, component resale
  - WW markets
  - Greater revenue opportunities
- Reuse demands nondestructive disassembly
  - Creating opportunities for finer liberation of:
    - Precious metal bearing components
    - CM bearing components

Addressing the Challenge

1. GEC proposed DOD project

2. iNEMI Value Recovery Project

iNEMI Project – Value Recovery from End of Life Electronics

- iNEMI engages stakeholders across the life cycle of electronic products to examine new approaches to managing critical resources and increasing value recovery while protecting human health, safety and the environment.
- Vision: an Eleanor Ostrom*-inspired project design for a circular economy:
  - Developing a voluntary, community-based solution involving adaptive governance systems for optimized self-management of common pool resources
  - With a path forward through multi-stakeholder collaboration
  - To develop a set of rules for the interaction of institutions across the value chain from design and manufacturing, through reuse, to end-of-life

* Dr. Eleanor Ostrom, 2009 Nobel Prize in Economics, Faculty: IU & ASU, author: Governing the Commons

Value Recovery from HDDs

- iNEMI project now focuses on a ubiquitous component, HDDs that carry unrealized reuse and CM recovery potential
  - Reuse of the HDD
  - Reuse of the magnets
  - Reuse of assemblies
- Current HDD processing depend upon shredding which destroys reuse potential and minimizes critical materials recovery
- More successful material recovery requires a three stream process at a minimum
- Can the recovery of collected NdFeB magnets in HDDs be a trusted and profitable supply source to meet a portion of Nd/Dy demand?
  - While addressing data security concerns

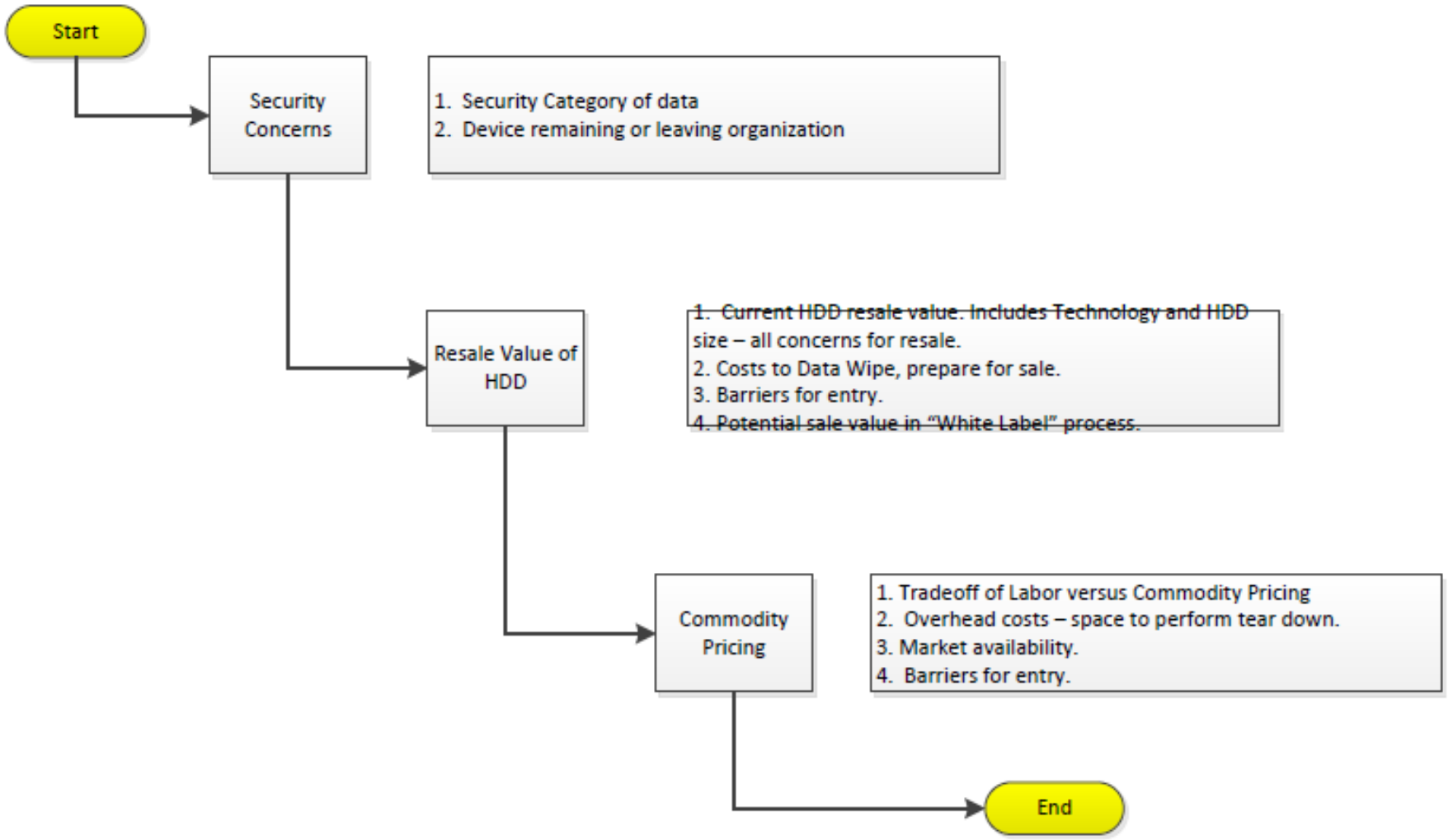
Current iNEMI Project Team

Name	Company
Carol Handwerker – co-chair	*Purdue*
Wayne Rifer – co-chair	*GEC*
Bill Olson	*Seagate*
Alice Lin; Jeffrey Lee	IST Group
Colin Fitzpatrick	University of Limerick
Gary Spencer	Geodis
Willie Cade	SUNY-Buffalo
Tim McIntyre	Oak Ridge NL
Alex King	Critical Material Institute
John Sutherland, Hongyue Jin	Purdue
Ardeshir Mashhadi, Mostafa Sabbaghi, Sara Behdad, Yosepho, Farzad Mehrpour	SUNY-Buffalo
Ian Lovell	Teleplan
Devin Imholte	Idaho National Lab

Value Recovery from HDDs

- The project is conducting economic, environmental, and logistical analyses to examine the viability of scenarios that can be applied to HDDs and other EoL electronics
- Scope of Work
  1. *Identify possible routes* to increase the value recovered
  2. *Develop a decision tree* to show the sequence of recovery choices including criteria to make decisions and handoffs required
  3. *Identify the current barriers* to a safe, environmentally sustainable, economically feasible recovery system
  4. *Identify next steps* to demonstrate the feasibility of the system

Current HDD Value Recovery Pathways



GEC Proposes a Strategic Role for DOD

- The DOD supply challenge of Critical and Strategic Materials (CSMs)
  - "To decrease the risk of dependence on foreign supplies" (2015 DOD report on Stockpile Requirements for SCMs – a biennial report)
  - Considering the possibility of a closed economy
  - The focus strategy is to purchase and stockpile
- A more sustainable strategic element
  - To not rely entirely on supply lines out of U.S, control
  - To build a SCM supply through recovery from scrap – defense equipment, electronics, etc.
- The massive market power of DOD could build their own supply, and enhance the financial of the entire recovery system
  - Strategic security policy could bring to play multiple policy instruments

A Potential Project

- Phase One
  - Identify the priority SCMs of greatest need and with greatest potential for sourcing through recovery
  - Analyze the current sources and handling of those priorities
  - Identify the barriers and the potential strategies to overcome those barriers
    - Pre-processing practices and technologies
    - System interdependencies
    - Financial and policy opportunities
- Phase Two
  - Develop the Implementation Plan that defines:
    - Recovery pathways for priority SCMs
    - Essential actors and roles
    - DOD initiatives to jump-start the system

A Potential New Reality for EoL Electronics

- The unsustainability of current EoL practices for electronics are under great scrutiny
  - By Congress, private foundations, universities, and organizations such as GEC
- Efforts are underway to actualize a more sustainable system
- CMI seeks to secure the supply it will need for the success of new CM recovery technologies
  - And thus can play a role in making electronics recycling more sustainable


THANK YOU