Sustainable Electronics Roadmap

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Based on Sustainable Electronics Form, October 15-18, 2012
The Johnson Foundation at Wingspread, Racine, WI



EPA Sustainable Electronics Forum

- EPA/ORD convened multi-stakeholder groups for Sustainable Electronic Forum
- October 15-18, 2012

  The Johnson Foundation at Wingspread, Racine, WI
- Co-sponsored by
  - The Johnson Foundation
  - Green Electronics Council

Green Electronics Council

The Johnson Foundation AT WINGSPREAD

Objectives of the Forum

- Develop a *shared vision of truly sustainable electronics* and provide clear end-goals for design standards development.
- Promote the *integration of end-of-life* (EoL) considerations into *front-end product designs*.
- Discuss methods to *extend the useful life of electronic* products and assess the optimal amount of time to keep products in operation.
- Support the creation of *environmental criteria* for refurbished equipment.
- Address other *high-priority questions and challenges* identified by the stakeholder community

Forum Participants

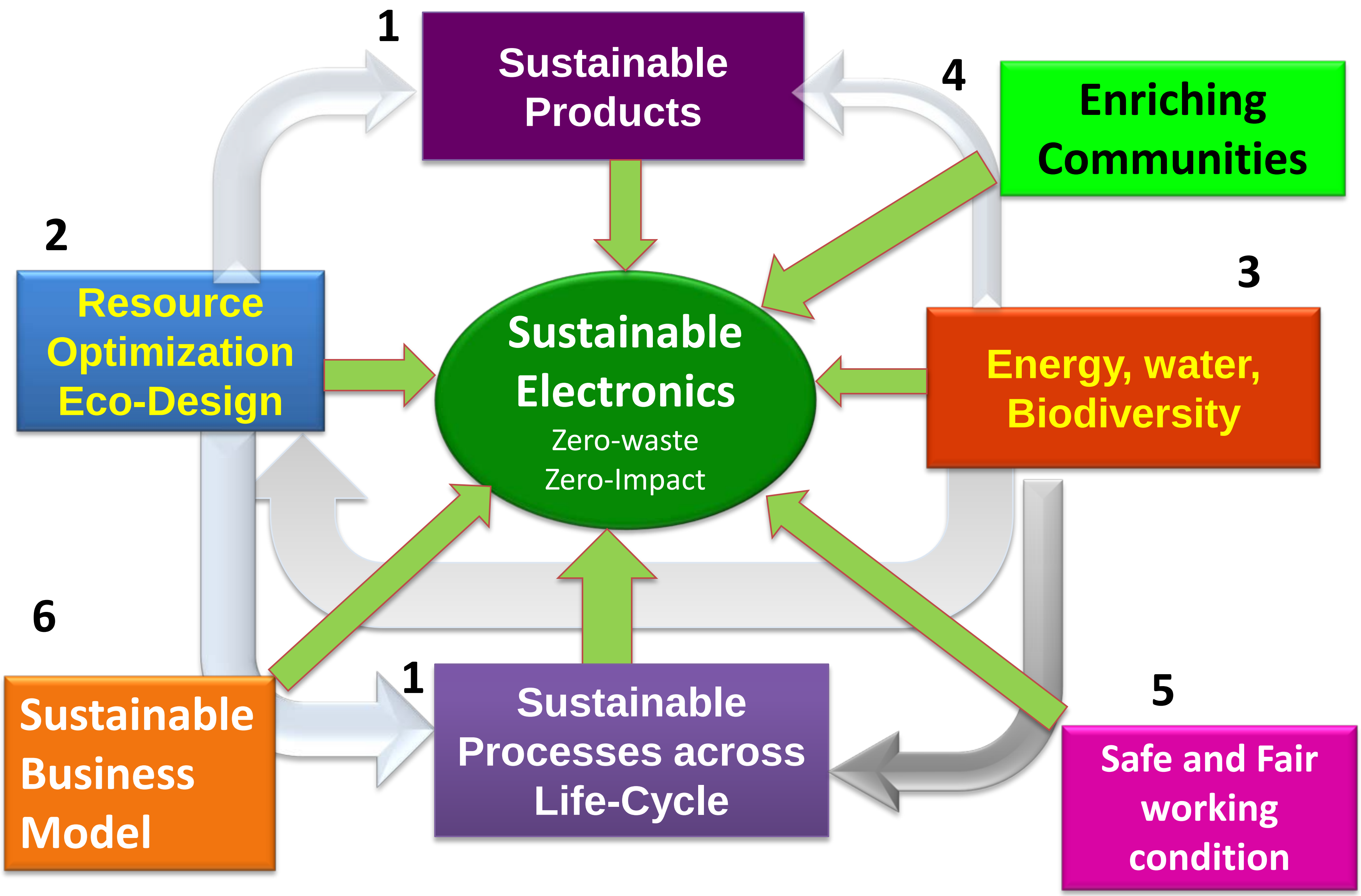
Participants	Affiliation
Academic	7
Industrial Manufacturing	5
Industrial – EoL	4
Environmental NGO	2
Association	6
Government	8
Facilitators / organizers	3

Vision Statement

" Sustainable ICT will enable us to protect and enhance human health and well-being and the environment over generations while minimizing the adverse life-cycle impacts of devices, infrastructure and services."

Sustainable Electronic Forum Summary,
Racine, WI, October 15-18, 2012

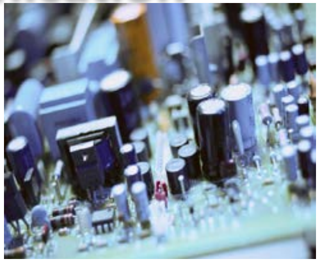
Sustainable Electronics Themes



Theme 1
Materials and Processes Cause No harm

Goal

- **Limit the harm posed by all information and communication technologies (ICTs) materials and process**



Objective

- *Complete inventory* and hazards of chemicals in production and electronic products,
- *Elimination of hazardous* toxics from electronic products and processes
- Design tools fully populated with materials and product hazard problems
- Virgin and recycled materials sources from certified facilities
- Alternative assessment should be made prior to selection of materials and chemical

Theme 1 - Research Questions
Sustainable Electronic Products

I. Chemicals in Electronic Products

- Develop practical and multipurpose tools / methods to assess chemical found in electronic products,
- Develop a method for hazardous materials that need to be replaced. “White” and “black” list, ranked by risk,
- Transparency, sharing information

II. Fate and transport of hazardous chemicals in products / processes

- Obtain better information on fate and transformation of chemicals through life cycle:
- Identify nanoscale materials, in electronic waste stream and their fate & transport

III. Search for replacement of hazardous chemicals with safer one

- Elimination of toxics in products and processes over the life cycle, eg. BFR, PVC, phthalet DEHP, DBP, BBP
- Replacement of hazardous and toxic chemicals with safer, biologically benign alternatives

IV Integration of chemical information in electronics with OEDs/OEMs/recyclers across the supply chain LC

- Integrate hazardous chemical information in the electronics process and product design.
- Create an EPA Green Star Program to direct purchasers to product standards that include these ideas in EPEAT
- Create a register of preferred chemicals for various processes and make the accessible to stakeholders

What are the Barriers

- ***Technical:***
  - Limited chemicals listed IEC 62474 - Material Declaration for Products of and for the Electrotechnical Industry
  - Lack of collaboration to collect chemical and process information
  - Challenge in handling proprietary information
  - Lack of transparency in the supply chain and fear of liability
- ***Infrastructure:*** Lack of method to bring information on hazards and alternatives to designers
- **Economical:** Lack of funding for developing effective alternative assessments

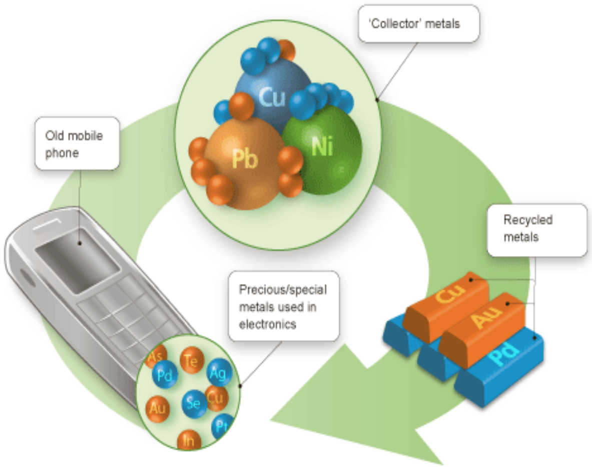
- ***Standards*** : Lack of agreement on preferred materials

What standards are needed

- **Consensus on harmful / benign chemicals**
- **Integrate a criterion for a full chemical inventory into Stanards used by EPEAT®**
- **Integrate a criterion for making information publicly available and verifiable**

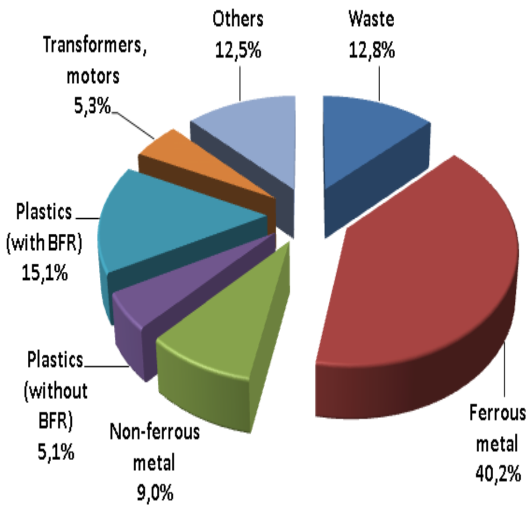
The Challenge: The good, the bad and the ugly

recovering valuables while taking care of hazards



E-scrap, a complex mix...

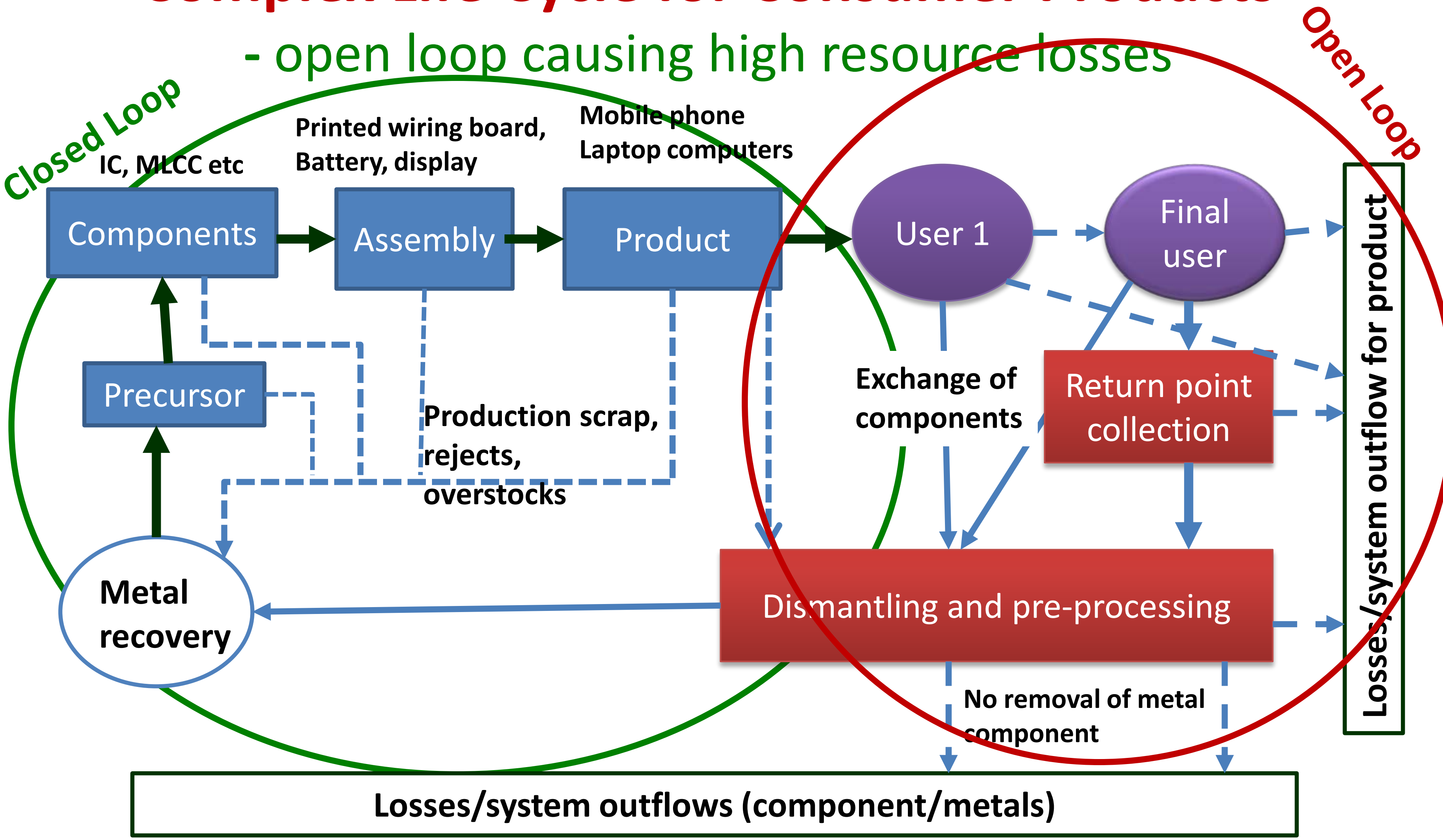
- Ag, Au, Pd...(precious metals)
- Cu, Al, Ni, Sn, Zn, Fe, Bi, Sb, In (base-and special metals)
- Hg, Be, Pb, Cd, As,...(substances of concern)
- Halogens (Br, F, Cl...)
- Plastics and Other organics
- Glass, Ceramics



- **Environmental Risk** in case of landfill and inappropriate recycling
- **Valuable metal resource**

Complex Life Cycle for Consumer Products

- open loop causing high resource losses



Multiple change of ownership, low transparency, High product mobility, global material flow
High exports of EoL products in regions without appropriate recycling infrastructure
Low consumer awareness on resource value and missing recycle incentives
“Hibernating” good and inefficient

Theme 2: Closing-the-Loop:
Eco-Design and Resource Optimization

Goal

Better management of closed-loop

- Better design
- Extended producer responsibility
- Industrial ecology
- Zero waste → Infinite recyclability of all products.

Objectives

I. **Product design for recycling and life extension**
   - Tracking & tracing of material flows / transparency creation

II. **Research on recovery of rare earth elements**
   - Recycling of Rare Earth elements such as Gallium, Germanium, Tantalum

III. **Increase the recycled content of plastics**

Theme 2: Closing-the-Loop:
Eco-Design and Resource Optimization

Proactive eco-design that take into account

- Design for disassembly (reuse and refurbishment), Life extension and recycling
- Design for recovery, avoid incompatible material mix if doesn't interfere with essential functionality
- Design for tracking and detection
- Design with less materials use

- **Transparent material Flow**
    - Commonly accepted standards for scope, quality

- **Optimize systems for priority devices**
    - Economic drivers
    - Technical – interface and process technology
    - Rules / incentive

Challenges in Metal recycling from complex products

1. Accessibility of relevant components/materials
   - ➢ Electronics in cars, REE magnets in electric motors,…
   - → "**Design for Disassembly**", mechanical processing, pre-shredding-technology

2. Thermodynamic limits for multicomponent mixtures of "trace elements' – cost effective recovery challenging
   - ➢ Rare earth, Gallium/Germanium, Lithium, Tantalum, …
   - → "**Design for Recycling**," fundamental metallurgical research, pilot plants

3. Severe deficits in closing the loop for consumer goods
   - ➢ Electronics, cars, batteries, lamps, …
   - → **Better collection**, tracing and tracking of material flows, transparency, economic incentives

Complex products require a systemic solution & interdisciplinary approaches: product design, mechanical processing, metallurgy, economics, ecology, social sciences

Theme 3: Energy, Water and Biodiversity

Goal

- ICT manufacture and EoL process to realize zero net energy and water use while taking steps to maximize biodiversity

Objective

- Maximize the benefits of ICT applications
- Decrease manufacturing and supply chain energy use, with the goal of zero net energy and CO_2 from manufacturing
- Decrease net water use
- Increase biodiversity

Theme 3: Energy, Water and Biodiversity Research Question

1. **Demonstration case studies to model efficient water and energy use and simple cost-efficient measures**

2. **Develop method for assessing lifecycle costs and environmental impacts electronics manufacturing and EOL processes**
   - Simplified Product and process LCA for key product segment
   - Environment, health and safety protection throughout product lifecycle of REE
   - Materials lifecycle optimization and what has highest risk?

3. **Energy use for unit of production not known**
   - **Energy STAR performance indicator takes 2-3 years to develop**
   - Need to measure energy use over time

4. **Develop alternative assessment tools**
   - Proactive and timely evaluation of ESH impact of new materials
   - How do can we integrate alternatives assessment into electronic process and product design tools.

5. **Maximize use of renewable energy**

Theme 4 : Enriching Communities

Goal

Communities benefit proportionally from extraction, production and EoL activities and are able to exercise self-determination in the development.

Needed

- Better mining practices - Responsible Mining with existing standards
- EPEAT optional points for offering redemption value for ICT
- Expand U.S. conflict mineral disclosure to more regions

Regulation

- Local government issue EoL policies to reduce “shopping” for perks

Barriers

- OEMs are high in the supply chain – costs are externalized
- Ignorance and apathy from consumers, avarice

Theme 5:
Safe and Fair Working Conditions

Goal

ICT is manufactured in facilities with best-in-class health, safety and environmental standards globally with living wages, no forced labor, no child labor, no discrimination and where workers have freedom of assembly.

Objectives

Research

- Identify best-in-class health, safety and environmental standards,
- Recommended or Permissible exposure limits (RELs) or (PEL)

Standards needed

- Global standards based on the Strategic Approach to International Ch
  Management (SAICM) recommendation
- Adopt ILO labor standards
- Regulation needed to implement global standards
- Cooperation between expertise – OSHA, NIOSH, WHO
- "Standards" for backyard processes

Theme 6: Business Model

Goal

Decision throughout the supply chain are aligned with sustainable objective

Issues

1. **Quarterly earning matrix**

   How could investments in the electronics industry support requiring companies to report on their long-term strategy and how it makes the business more sustainable.

2. **Asses business models for optimization of product lifecycle**

   How do we incentivize companies to design and build products to be long lasting and upgradeable, easy to repair, and easy to refurbish for a significant reuse phase?

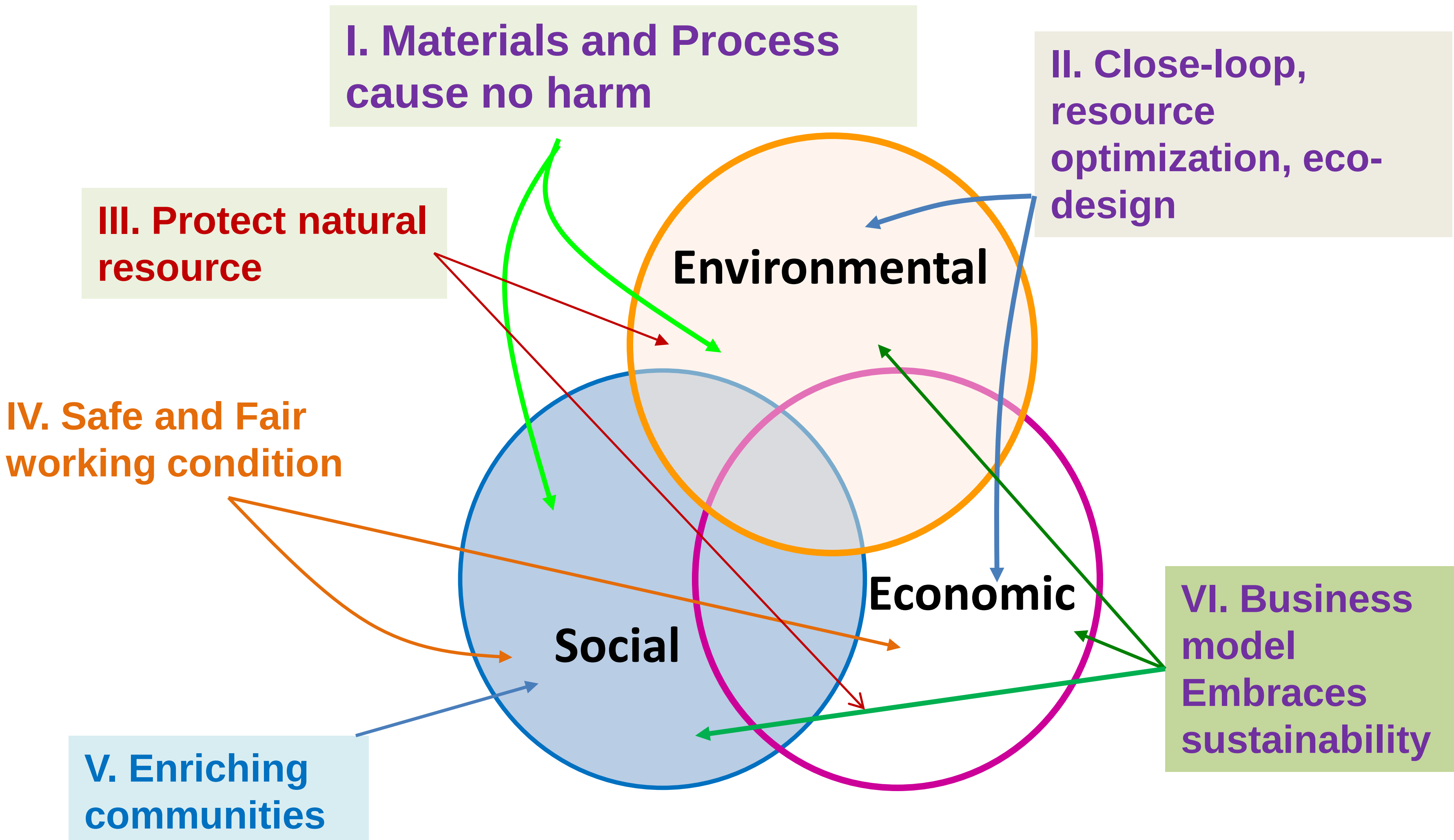
Theme 6: Sustainable Business Model

3. **Determine ways for cost internalization**
   - Develop methods to asses the true costs for each phase of electronics in their lifecycle.
   - Identify categories of externalized costs in each phase of the lifecycle?
   - Develop appropriate methodology for itemizing costs in each category.

4. **Lack of standards applicable per industry sector that can help companies establish best practices**

5. **Product longevity and ease of repair and upgrade**
   - What is the current rate of product turnover category?
   - Would we pay more for the “Volvo” of laptops?
   - Upgrade Vs. replacement – comparison between business and consumer
   - How can a truly modular design enable upgrading?

The Three Spheres of Sustainability



Sustainable Electronics Research Topics EPA/ORD

1. Life Cycle Assessment and Alternative Assessment Tools

- Research to identifying potential environmental trade-offs for reuse and recycle of materials in electronics including rare earth elements and plastics (CSS Research and SBIR grants)
- Develop comprehensive methodology to evaluate the total impact of changes in products, materials, services
- Developing a proactive and timely tool for evaluation of ESH impact of new materials
- Research to identifying potential environmental trade-offs for reuse and recycle of materials in electronics including rare earth elements and plastics

2. Sustainable Electronic Products and Processes

- **Identify hazardous substances within the life cycle of electronic products.**
- **Information on fate, transformation and transport of chemicals used in electronic**
- **Create Innovation Challenges: ORD & OSWER challenged industry to develop a system for tracking electronics devices as well as their chemical contents to advance recycling and recovery of valuable products**

Sustainable Electronics Research Topics

3. **Green Chemicals and Cleaner Processes Replacement of hazardous chemicals with safer alternative**

    - Search for safer alternative substitutions for top toxic products
    - **Improve Standards and E-waste Tracking:** Support EPEAT on developing new standards for environmental preferred products/ Support funding for UN (StEP) E-Waste Tracking Study

4. **Develop Best Practice for Protecting Workers and Communities**

    EPA/NIOSH/OSHA will study to develop a best practice health scorecard/auditing tool that can be used to evaluate current performance worldwide for both manufacturing and recycling

The Roadmap

- Identified set of short- and long-term needs and the technologies required to satisfy those needs
- Provides a mechanism to help forecast technology developments
- provides a framework to help plan and coordinate technology developments.
- Helps to inform and shape research and technology priorities
- iNEMI has incorporated many components in plans
- Final report will be at web sites

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Thank you !