Design for Recycling
Design for Recycling

- Sustainable Development
- Industrial Ecology
- DFE
  - Energy Use Reduction
  - DFR
  - Substance Reduction
Design for Recycling
Proper consideration of a product's environmental impact during the product's design phase is of paramount importance for American electronic manufacturers. Not only to avoid increased regulation and potential environmental liability, but, also, to maintain competitiveness in a marketplace full of increasingly environmentally conscious consumers.
Why is DFR Important?

A competitive issue

• “At the heart of the decline of competitiveness is “the failure...to create industries of the future”” -- Gary Hamel, London Business School

A bottom line issue

• “Once industrialists think about it at all seriously, they almost inevitably see the financial advantages of investments in environmental technology” -- Hugh Faulkner, Business Council for Sustainable Development
Why is DFR Important?

A legal issue

- 12 countries have take-back laws on the books
- 26 States have passed laws addressing e-waste
- Most popular format is Extended Producer Responsibility (EPR)
- For more information on state laws visit www.electronicsrecycling.org/
Design for Recycling

Two elements

• Design for Reuse
  ▪ Reuse--The ability to take an item after it has been expended and inject it back into the production or repair process in its initially designed form.

• Design for Recycling
  ▪ Recycling--The ability to take an item after it has been expended and return it to usefulness in an alternative form or as a commodity.
Design for Recyclability

Design for Recycling
- Molding versus labels
- IC recovery
- Packing material recovery

Design for Reuse
- Toner Cartridge Recovery
- Disposable cameras
Reuse

Extending product life

- Avoid manufacturing new products
- Help bridge the digital divide
- Potential Manufacturing Cost Savings

Issues

- Interchangeability
- Data Erasure
Design for Recycling
Closed Loop Reuse/Recovery

Figure 1: Closed loop reuse/recycling system
Two Primary Methodologies

- Demanufacturing
- Destructive Disassembly (shredding)
Recycling Improvements

Economic Improvements
• Decrease disassembly time
• Increase liberated value
• Decrease learning curve

Environmental Improvements
• Increase recyclable content
Disassembly Curve

Figure 2: Net Revenue Curve
Disassembly Time

Disassembly Time Difference

Number of Units

Old Design

Improved Design
Common DFR Analysis Results

Dissimilar connection methodologies across subassemblies
Labeling issues
BOM issues
Complexity of interconnect design
How can design for reuse and design for recycling be incorporated into the initial product design process?

By giving the designer an awareness of the reuse/recycling processes, design decisions can be made that will minimize the product's end of life cycle environmental impact.

- In many cases these decisions will not impact overall product cost, especially when overall product life costs are considered.
- In some cases, these decisions can only be made by tradeoff analysis.