

# DESIGN *for* DISASSEMBLY



# What is **DESIGN** *for* **DISASSEMBLY**?



Designing a product with the intention of taking it apart and recycling or reusing the parts and/or materials it is made of.

# Why DESIGN *for* DISASSEMBLY?



It's another step consumers and corporations can take part in  
to protect the environment.

It fits into future business and regulatory scenarios

Easy to disassemble = easy to assemble = cost savings



Awareness is growing and so is the desire to take action



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Many corporations have already begun embracing sustainable business and product options





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### Efforts Grow to Design for Disassembly

It will be increasingly important to consider how products can be taken apart for easier recycling

*Doug Smock, Contributing Editor -- Design News, November 19, 2007*

Keep an eye on design for recycling. It's long been a backburner issue at the great majority of American companies, but that may change.

Two new directives require companies to take responsibility for their products sold in the European Union after their useful life. The **Waste Electrical and Electronic Equipment Directive (WEEE)**, which was enacted as European Union Law in 2003 along with RoHS, is finally starting to grab hold after member states

CEMs, manufacturers and others are **required** to develop an infrastructure to collect computers, household appliances, cell phones, lighting equipment, medical equipment and other electronic waste and then to recycle or re-use as much of the material as possible. The law became **effective** in the United Kingdom on July 1. Manufacturers are paying a fee to cover the cost of collection and recycling of goods they produce.

Producers in countries such as Germany are already taking responsibility for post-consumer waste by collecting products at municipal waste sites. It behooves them to make their products as recycleable as possible to reduce costs of the process.

Three states in the U.S. have promulgated electrical waste legislation and bills are pending in a dozen others. The most important **law**, in California, requires

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Hewlett Packard has Design-For-Environment guidelines (DfE)  
 Part of this effort includes Design for recyclability



Walmart has taken a very broad approach to sustainability.  
Sustainable 360 includes redirecting waste and improving product packaging.



## THE DESIGNERS ACCORD

*Last updated: August 11, 2010*

**675 Design Firm Adopters**

**34 Educational Institution Adopters**

**36 Corporate Adopters**

**100 Countries**

**6 Continents**

**All design disciplines**



The Designers Accord is a global coalition of designers, educators, and business leaders working together to create positive environmental and social impact

# Why **DESIGN** *for* **DISASSEMBLY**?



Another step in protecting the environment that consumers and corporations can take a part in.

It fits into future business and regulatory scenarios.

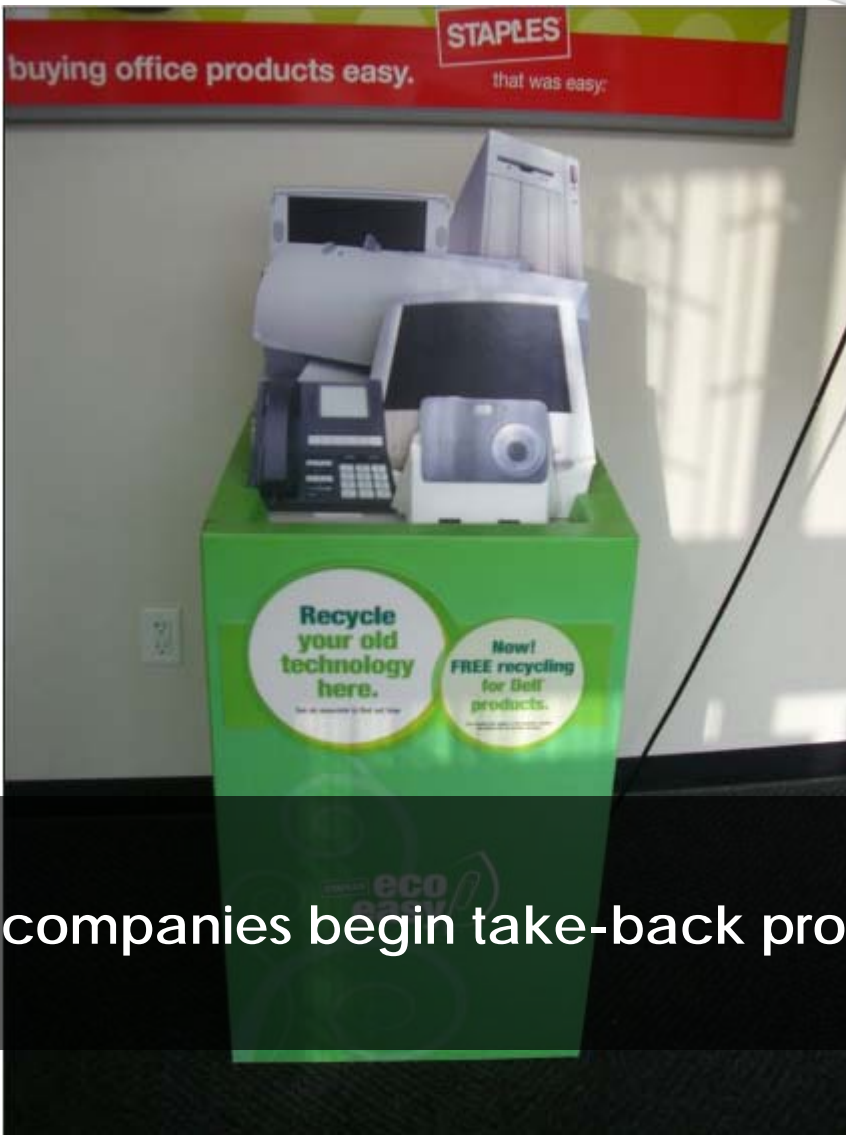
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## Take Back Laws Currently in place across Europe

- **End of Life Vehicle Act** of 2002 for Extended Producer Responsibility (EPR) with cars
- **WEEE** – Waste Electrical and Electronic Equipment Directive
  - Places the responsibility of disposing electronic products with their manufacturers





US companies begin take-back programs



Standardized  
identification symbols



Existing infrastructure in place for recycling

# Recyclebank

Using incentives to inspire recycling

01 Recycle

02 Record (*RFID garbage cans*)

03 Reward (*Recyclebank points*)



New industries are emerging

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Designing for easier disassembly requires embracing simpler solutions to assembly.



Most disassembly time is spent on fastener removal.  
Changing tools cost time.  
Many adhesives cause contamination of parts for material recycling.



Reduces maintenance and repair time



# DESIGN *for* DISASSEMBLY



Design Concepts' guidelines



Labeling



Choosing Materials



Fastening & Connecting



Finishing



Process



# Labeling

Provide Standard and permanent identification of material types on the product.

[The Society of the Plastics Industry, Inc. \(SPI\)](#) introduced in 1988

Permanently identify points of disassembly on the product.

Provide guidance to customers within manuals.



*ISO International standard 11469 states plastic over 25g gets a label*



# Choosing Materials



Minimize the number of different materials.

Avoid composite materials and make inseparable subassemblies from the same material.

Use recycled and recyclable materials.

Avoid toxic and hazardous materials.

Consider alternative materials.



# Choosing Materials

## Sources:

Material vendors

ASM/Mtrl is an industry initiative to support designers making material choices

<http://mtrl.asminternational.org/portal/site/mtrl/>

The screenshot shows the homepage of the ASM/Mtrl website. At the top left is the ASM logo (The Materials Information Society) and the Mtrl logo (Material about materials). To the right is a search bar with a 'Search' button and a link to 'Advanced Search'. Below the navigation bar are links for 'Home', 'Mtrl', 'Info', 'Learn', and 'Shop'. The main content area features a large banner with the text: 'Material is what design is made of. This statement is why we exist; to raise awareness, facilitate learning, and inspire innovation within the world of materials. Materials are what make our experiences tangible and impact the world around us.' The banner is divided into four colored sections: 'Mtrl' (black), 'Info' (blue), 'Wrkshp' (green), and 'Prcss' (orange). At the bottom, there is a footer with the ASM logo, copyright information '© 2009 ASM International', links for 'About ASM/Mtrl', 'Contact Us', and 'Legal', and a 'Subscribe to Newsletter' button.



# Choosing Materials

## Solid Works

The screenshot displays the SolidWorks interface with the 'Find Similar Material' dialog box open. The dialog box shows a table of materials with their properties and an 'Environmental Impact' section with four pie charts for Carbon, Energy, Air, and Water. The 'Environmental Impact' panel on the right shows a comparison of the current material (ABS PC) with a previous material (Nylon 6/10) across four categories: Carbon, Energy, Air, and Water. The current material has a higher impact in all categories compared to the previous material.

Materials	Specific Heat	Density	Elastic Modulus	Shear Modulus	Thermal Condu...
ABS PC	1900	1070	2.41e+009	8.622e+008	0.2618
ABS	1386	1020	2e+009	3.189e+008	0.2256
ABS PC	1900	1070	2.41e+009	8.622e+008	0.2618
Acrylic (Medium...	1500	1200	2.4e+009	8.9e+008	0.21
Delrin 2700 NC...			2.9e+009		
Nylon 101	1500		1e+009		0.53
Nylon 6/10	1500	1400	8.3e+009	3.3e+009	0.53
PA Type 6	1601	1120	2.62e+009	9.70e+008	0.233
PBT General Pu...	1421	1300	1.93e+009	6.902e+008	0.2741
PC High Viscosity	1535	1190	2.32e+009	8.291e+008	0.189
PE High Density	1796	952	1.07e+009	3.772e+008	0.461
PE Low/Medium...	1842	917	1.72e+008	5.94e+007	0.322
Perspex (TM) G...		1190			
POM Acetal Co...	1378	1390	2.5e+009	9.328e+008	0.221
PP Copolymer	1881	890	8.95e+008	3.158e+008	0.147
PS Medium/High...	1691	1040	2.28e+009	8.173e+008	0.121

**Environmental Impact**

Category	Selected	Original
Carbon	0.16kg	0.29kg
Energy	2.74MJ	4.03MJ
Air	0.00088kg	0.0024kg
Water	7e-008kg	1.0016kg

**Environmental Impact Comparison**

Category	Current	Previous
Carbon	0.28 kg	0.12 kg
Energy	4.03 MJ	1.99 MJ
Air	0.00 kg	0.00 kg
Water	0.00 kg	0.00 kg



# Fastening & Connecting

Use mechanical connections between dissimilar materials.

Use the minimum number of fasteners or connectors.

Use the minimum number of fastener and connector *types*.





# Fastening & Connecting

## Best Option

1. *Snap fits*
2. *Fastener*
3. *Heat stake*
4. *Ultra Sonic*
5. *Hot Plate Welding*
6. *Solvent Bond*
7. *UV Cured*
8. *Adhesives*
9. *Hot Wire*

## Worst Option





# Finishing

Avoid secondary finishes to materials.

Utilize finishes with minimal Volatile Organic Compounds (VOC's).

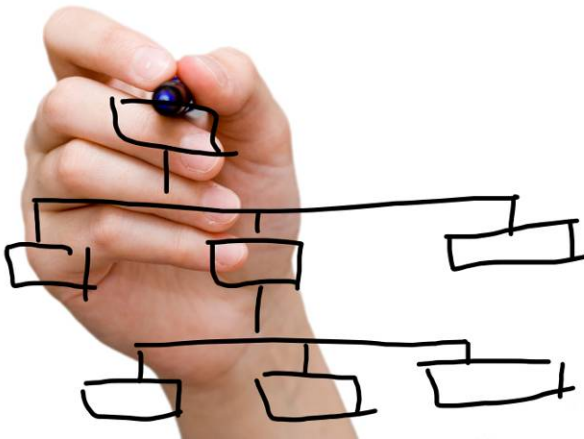




# Process

Use modular design to minimize different types of components.

Use manufacturing technologies that are compatible with standard, simple, 'low-tech' practices and tools.





# Process

Work with external certifying organizations and standards.

Optimize energy use during all pre and post production transportation, actual production and end use.

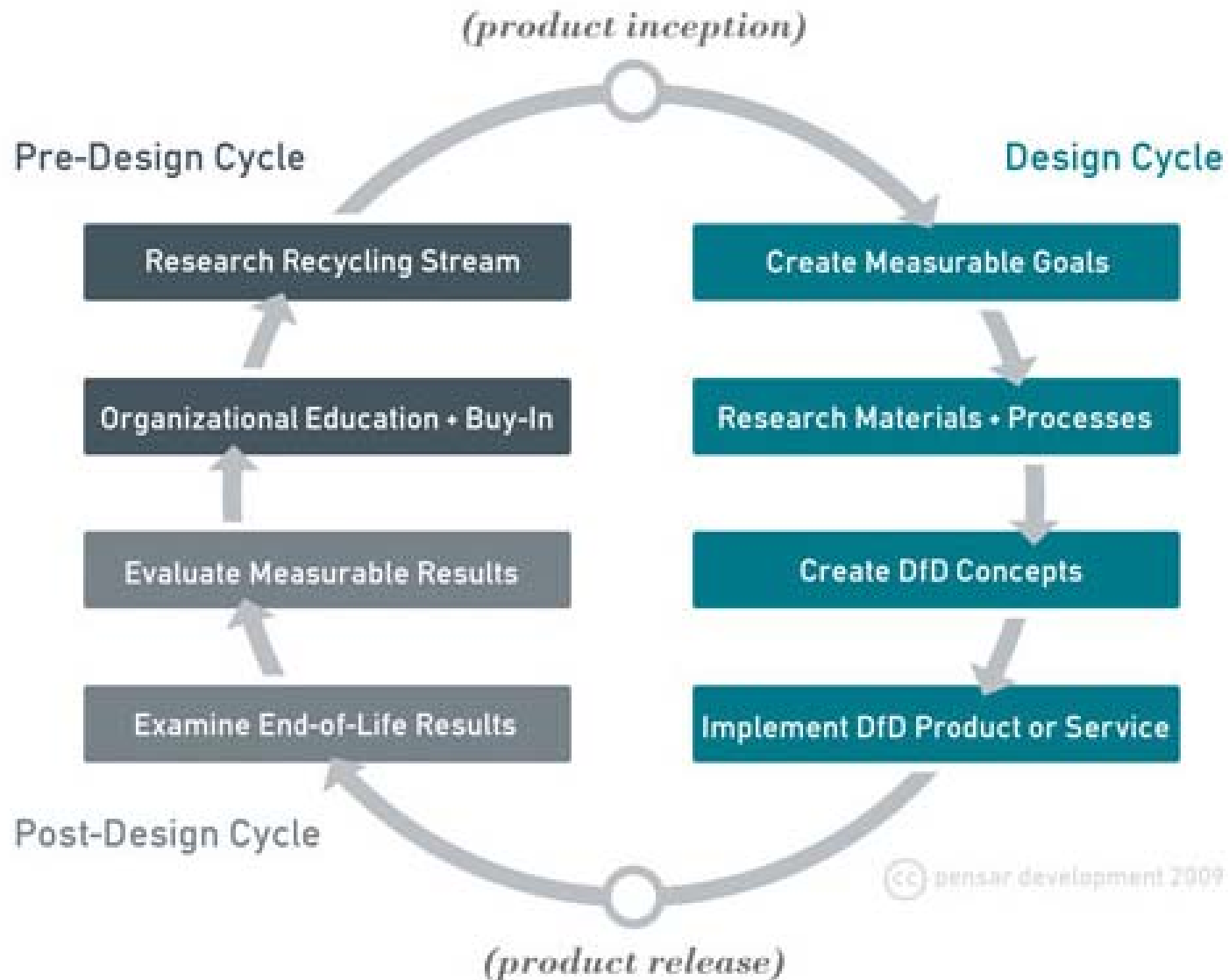
Optimize water use throughout pre and post production processes, actual production and end use.



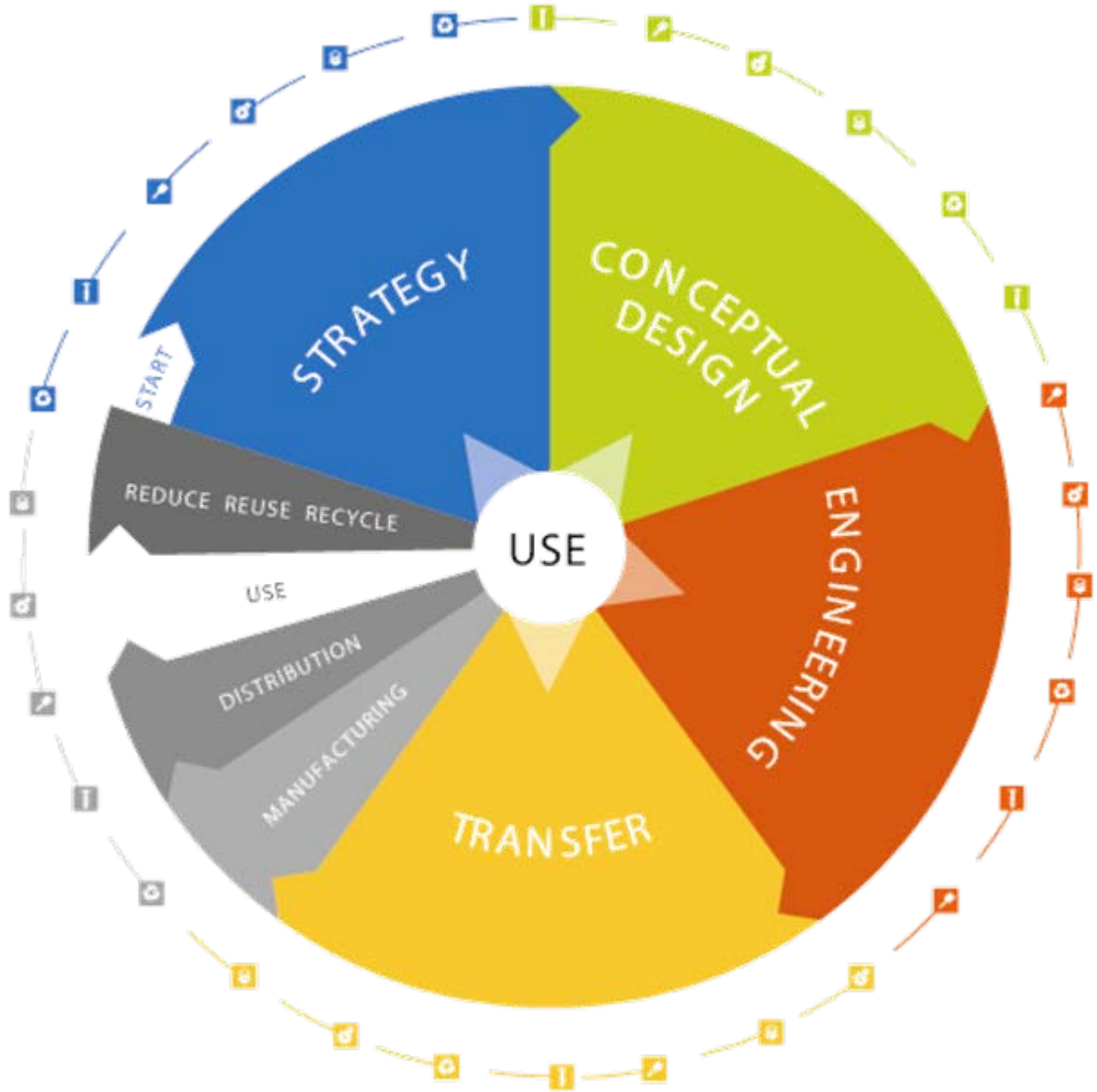
# DESIGN *for* DISASSEMBLY



Process and implementation



*The Design for Disassembly roadmap.*



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**Be prepared to...**

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**To make tough decisions**

**Understand trade offs and compromises**

**Break old habits**

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Thank you!

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**Any questions?**