
Cradle to Cradle®

Design Protocol and Product Certification Program

AA Symposium I

June 9th 2010



Cradle to CradleSM is a service mark of MBDC.

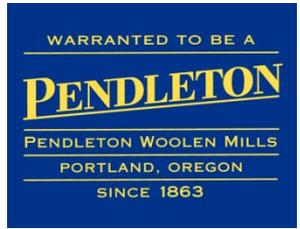
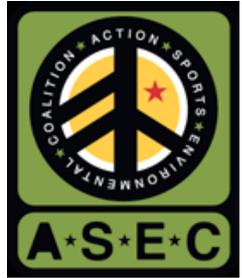
Who/What is MBDC?

- MBDC is McDonough Braungart Design Chemistry
- Product and process design firm founded in 1995 by William McDonough and Michael Braungart
- Core staff of ~15, located in Charlottesville, VA
- Focus on identification of CoCs and alternatives
- Originators of the Cradle to Cradle philosophy, design protocol and certification program



“Design Chemistry”

- True merger of Chemistry and Design
- Achieving the highest standards of *design*
- Beginning with a scientific understanding of the basic *chemistry* of materials, products and processes
- Expanding the definition of “Quality”



Agenda

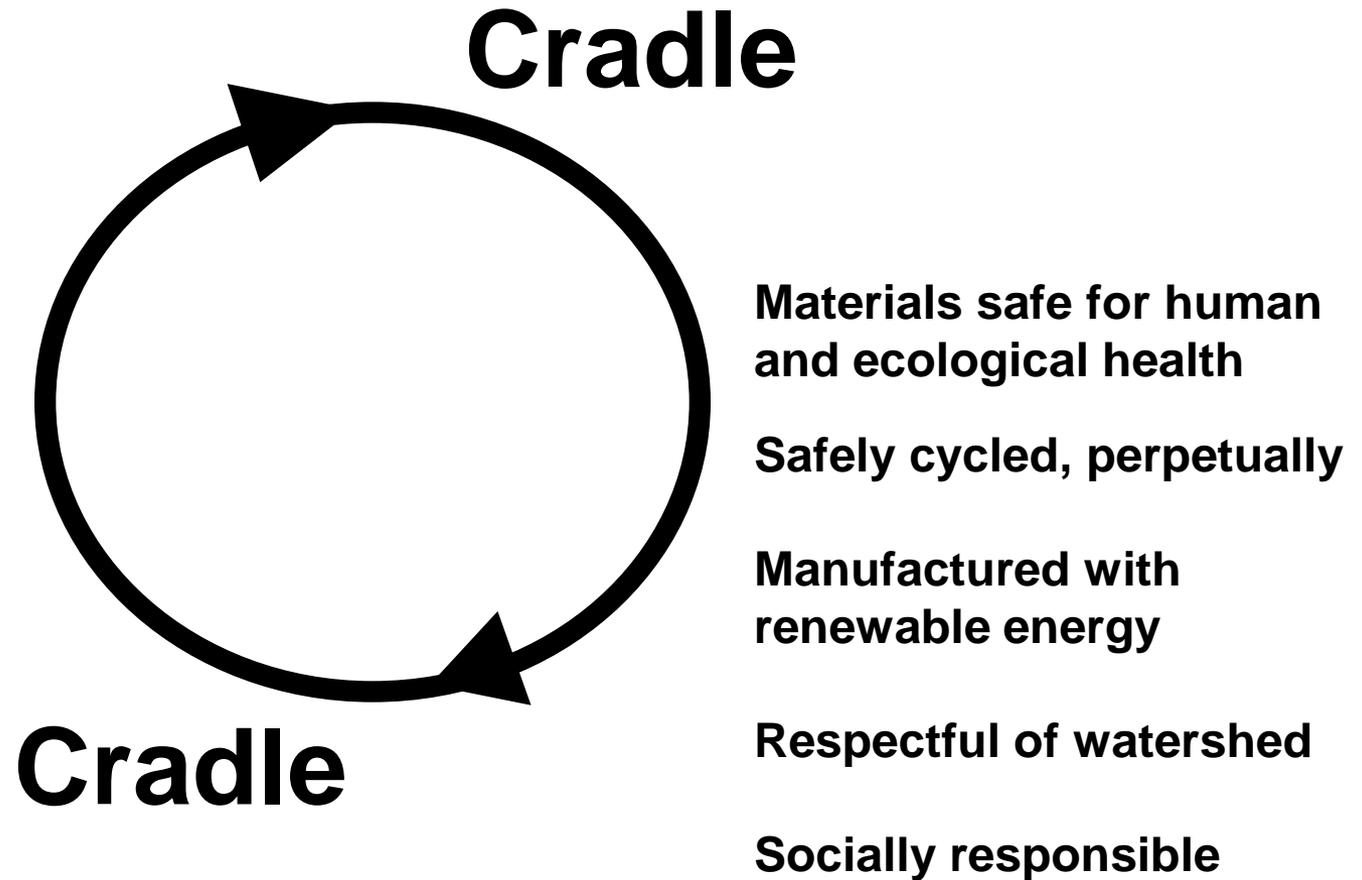
- Cradle to Cradle® Design Protocol
- Cradle to Cradle® Certification Program
- Cradle to Cradle® Alternatives Analysis

Traditional Product Design

Cradle to Grave Product Life Cycle

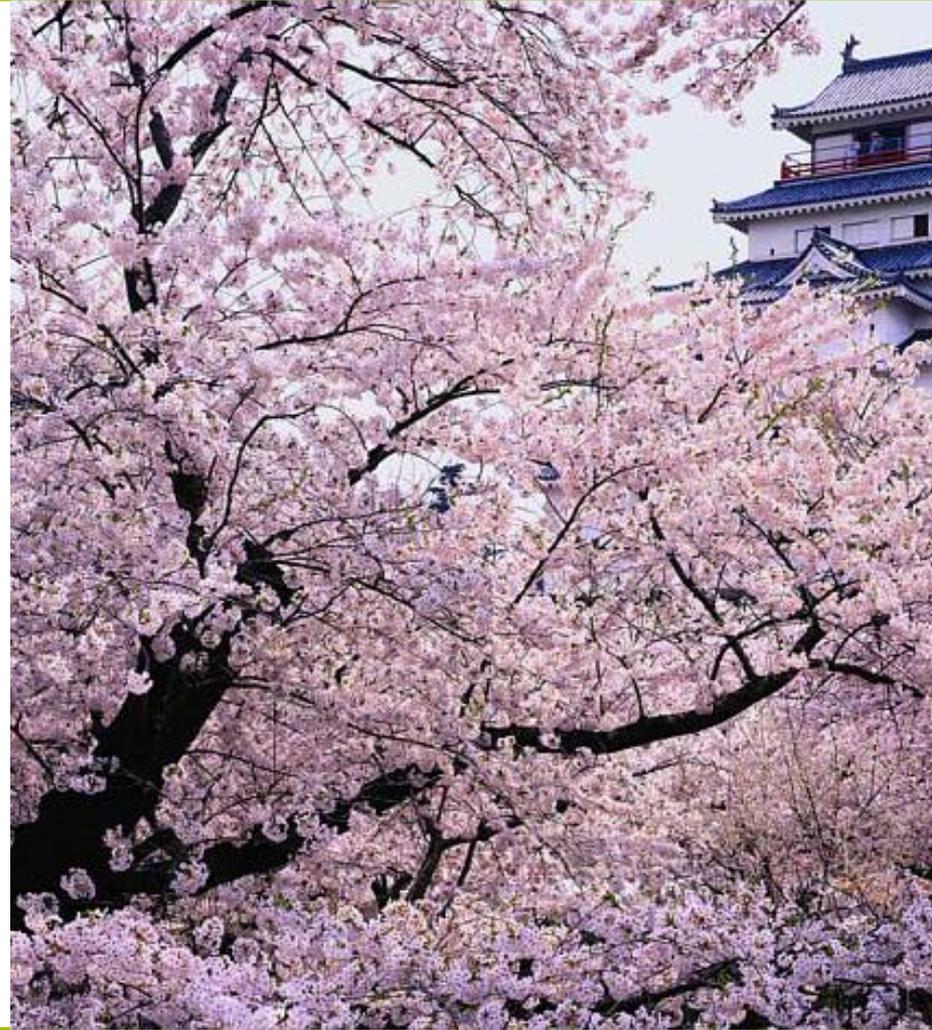


Future Design Paradigm

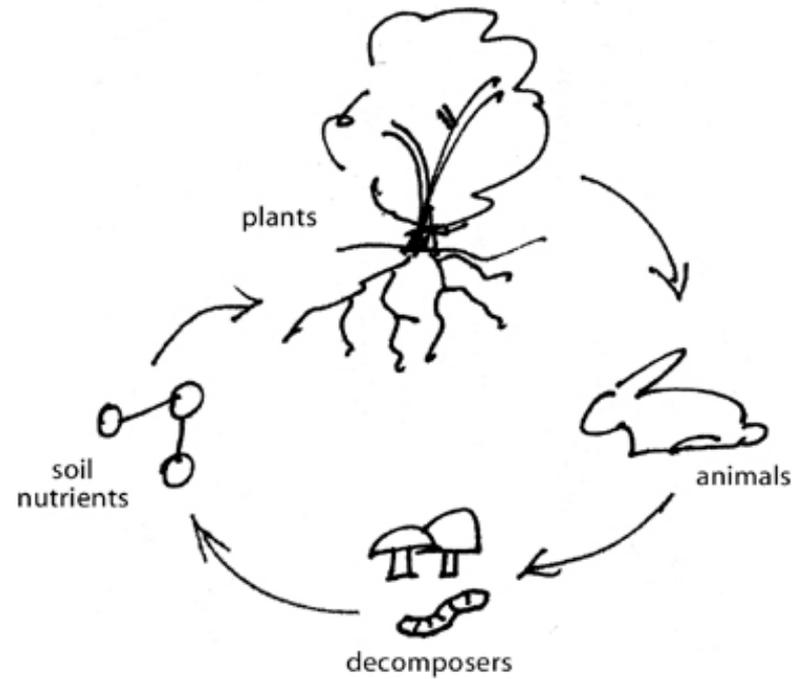


Design Modeled on Nature

- Nature focuses primarily on *effectiveness* (pursuing the most valuable end)
 - Then it may be *efficient*
 - Abundance, instead of minimization only
- Eco-effectiveness embraces nature's design principles

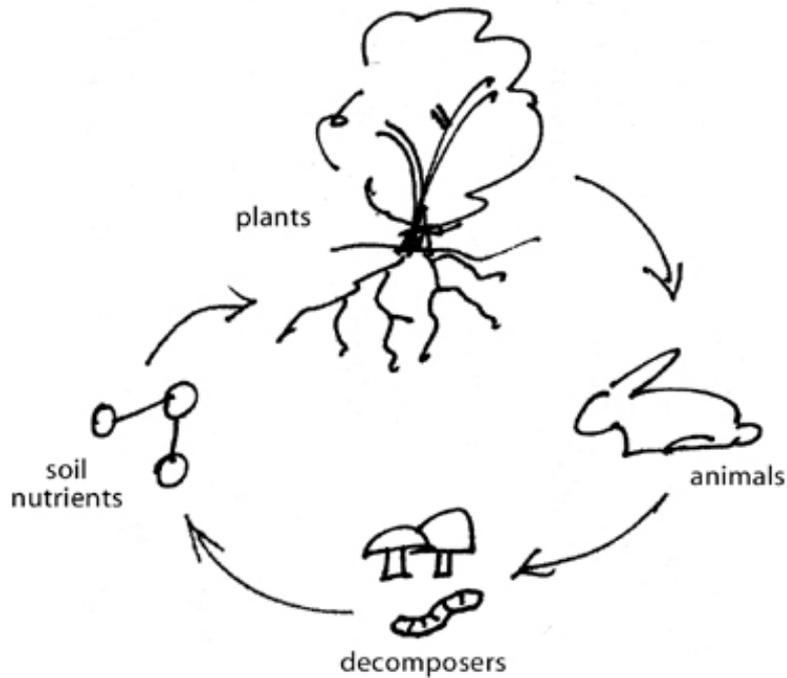


Natural Cycles

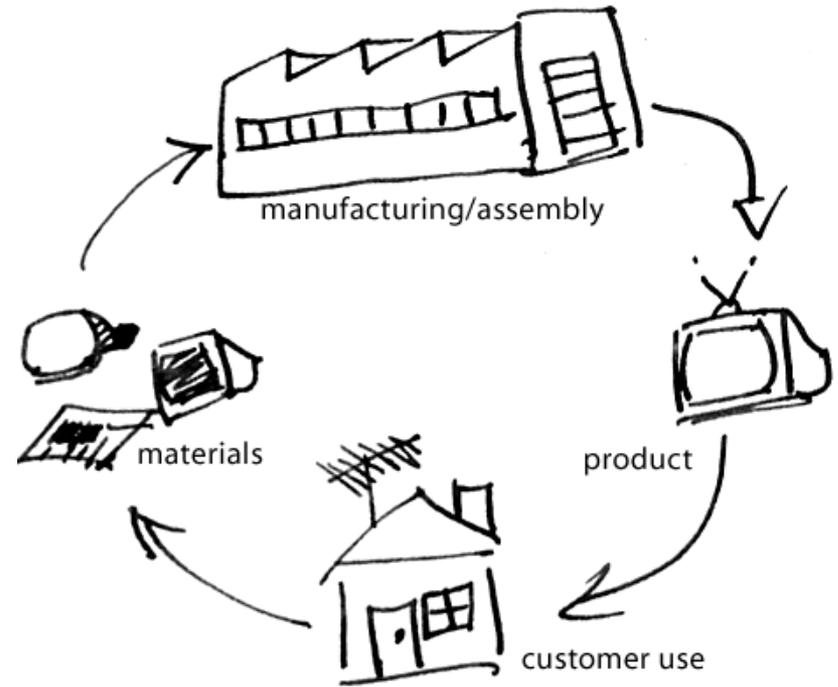


Biology 101

Emulating Natural Cycles

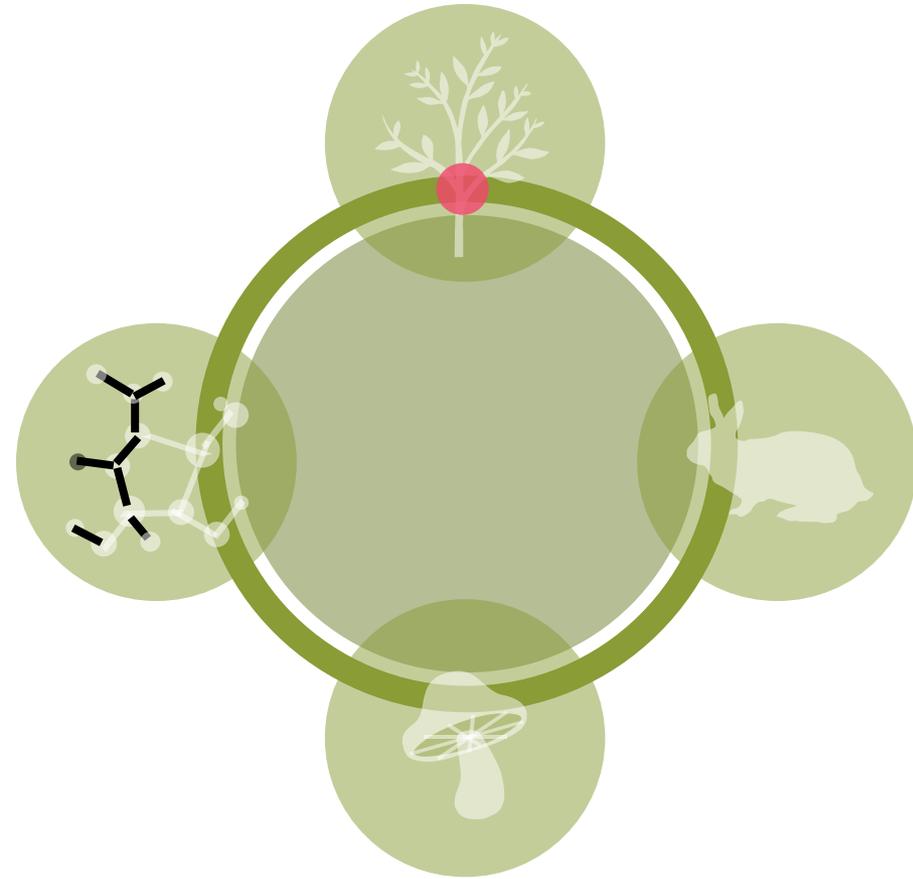


Biological
Nutrients

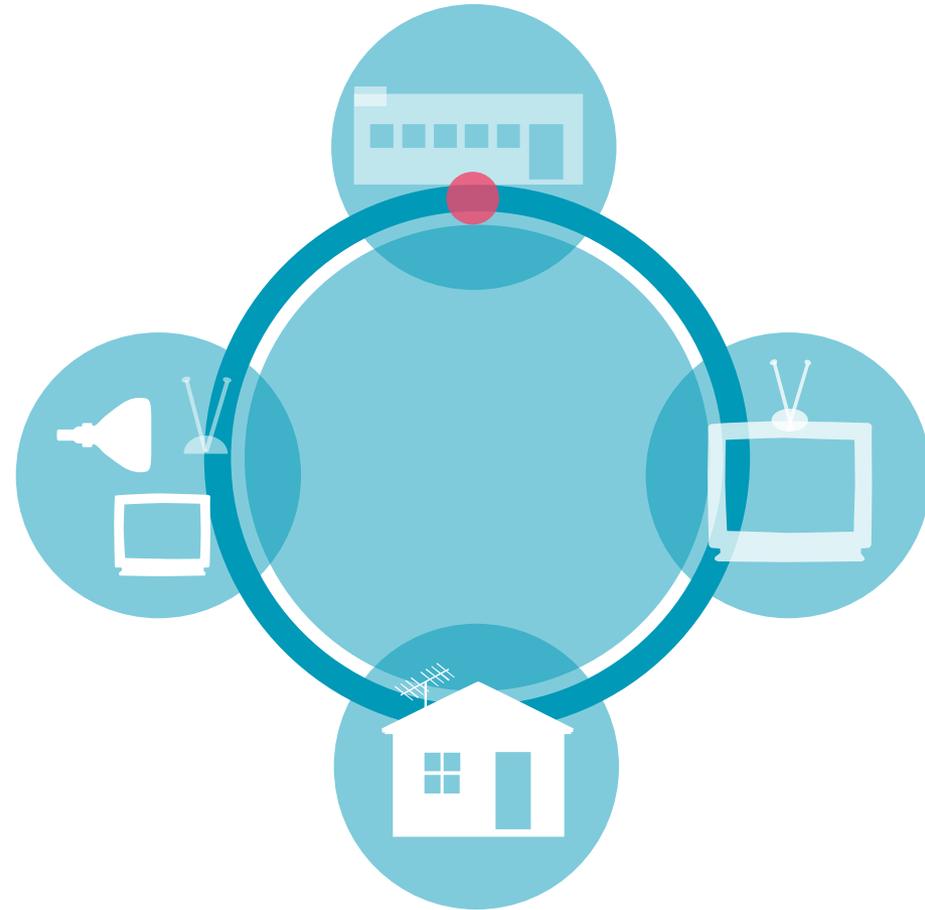


Technical
Nutrients

Two Metabolisms



Biological
Metabolism

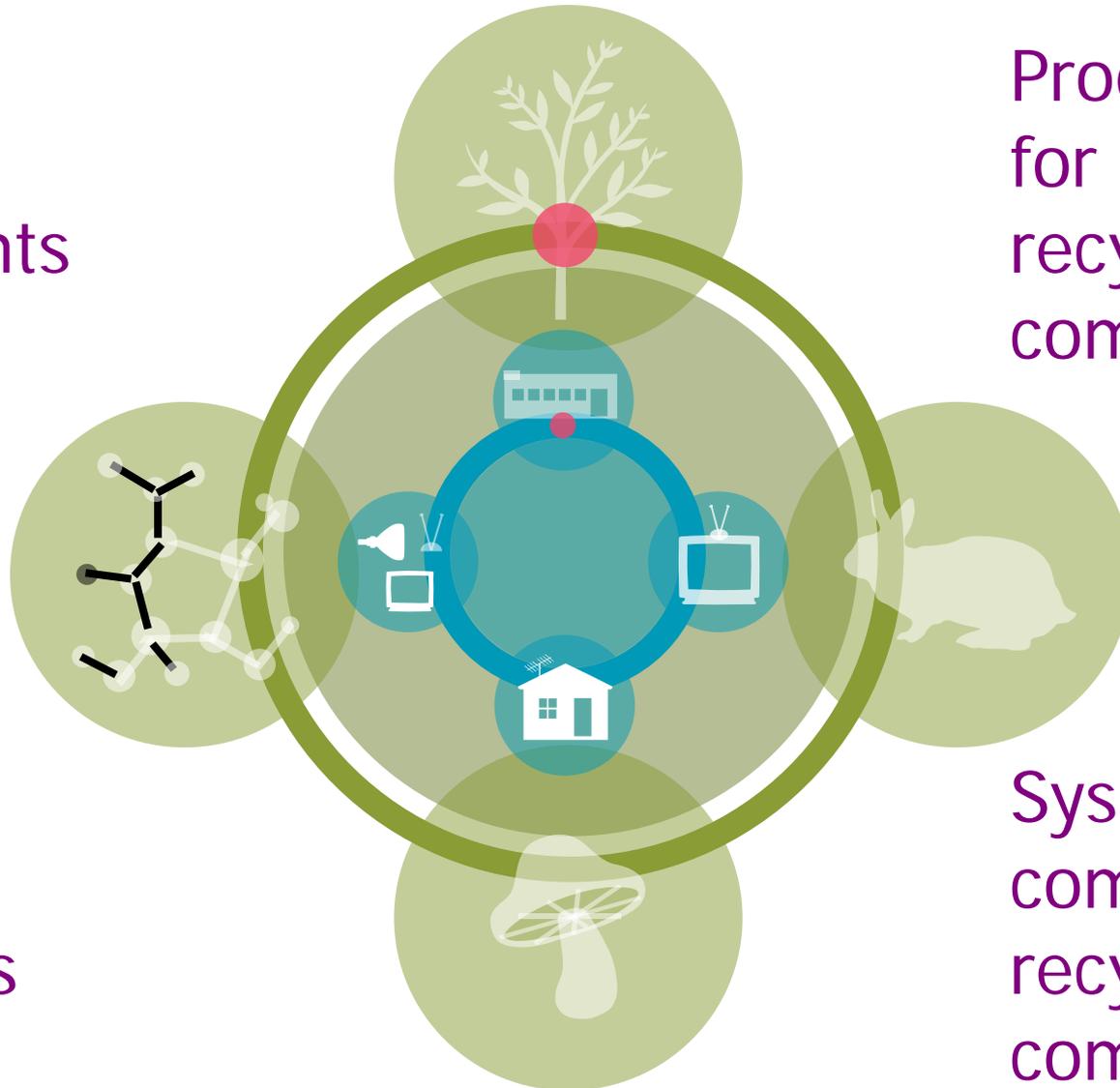


Technical
Metabolism

Nested, Interdependent Metabolisms

Safe,
healthy
ingredients

Product design
for
recyclability /
compostability

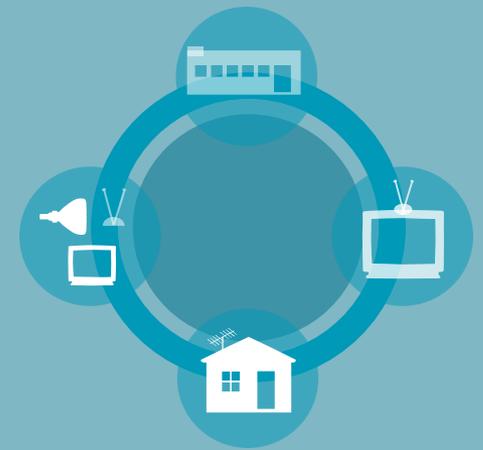
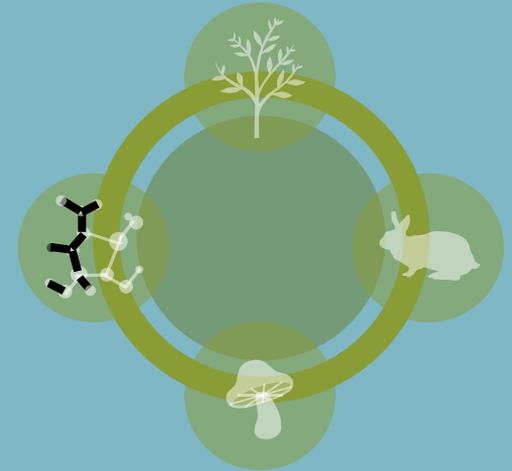


Reorient
design
principles

Systems for
complete
recycling /
composting

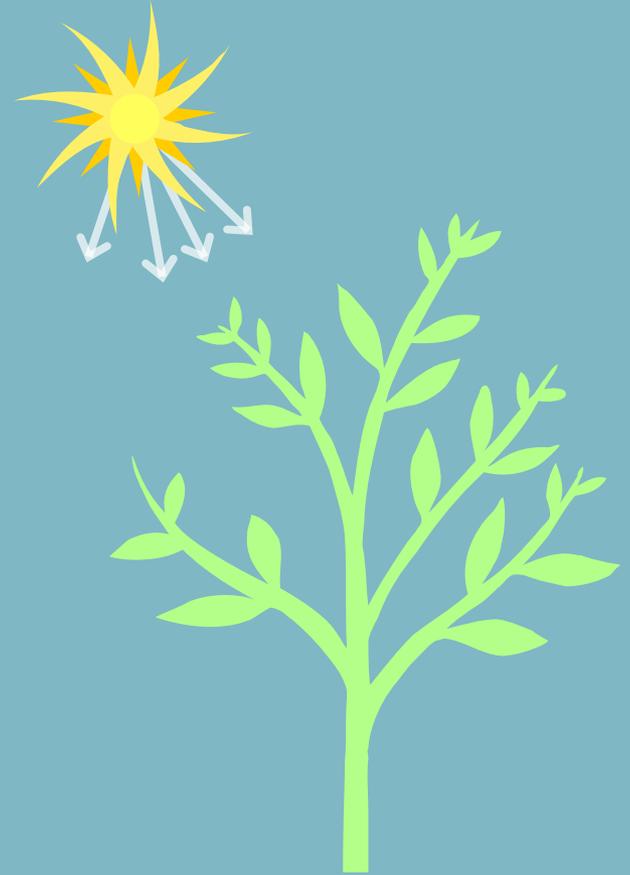
Cradle to Cradle Design Principles

Waste equals food



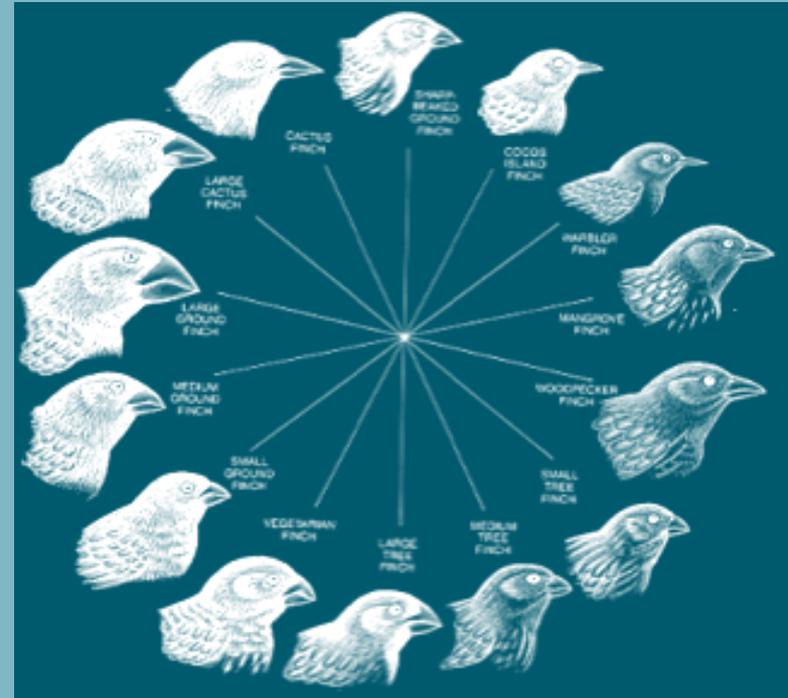
Cradle to Cradle Design Principles

Waste equals food
Use current solar
income



Cradle to Cradle Design Principles

Waste equals food
Use current solar
income
Celebrate diversity



Cradle to Cradle Design Principles

- *“Waste equals food”*
 - Material life cycles safe for human health & environment
 - Safely cycled, perpetually: recyclable, DfD, recovery system
 - Materials & products continually reused
- *“Use current solar income”*
 - Power with renewable energy
- *“Celebrate diversity”*
 - Human rights, including future generations
 - Ecological rights
 - Water use & water quality
 - Not one-size-fits-all solutions

Cradle to Cradle® Certification



Cradle to CradleSM is a service mark of MBDC.



Cradle to Cradle Certification



BASIC



SILVER



GOLD



PLATINUM

Cradle to Cradle Certified^{CM} is a certification mark of MBDC.

Overview

- Applicable to all industry sectors
- Applicable to materials, sub-assemblies and finished products
- Not binary “pass/fail” – 4 levels of achievement
- Focus is on continuous improvement
- Annual renewal
- Program is moving to GPII



Certification Stats

- Launched in October of 2005
- Over 100 Manufacturers Participating
- ~350 Certified Products
- Grown by ~50% over the past 12 months
- Version 3.0 revision underway



Certification Criteria

- 1.0 Materials
- 2.0 Material Reutilization/DfE
- 3.0 Energy
- 4.0 Water
- 5.0 Social Responsibility

Cradle to Cradle
Certified^{CM} Product

- Platinum 
- Gold 
- Silver 
- Basic 

- Combination of product metrics & company metrics
- Intention: spur innovation & ongoing optimization



Cradle to Cradle Certified^{CM} is a certification mark of MBDC.



1.0 Material Health

Deconstructing the Product

- Break product down into main components, subassemblies, etc.
- Break those down into homogeneous material streams
- Break materials down into chemicals
- Begin evaluation at the chemical level

Chemical Profiling

- A way to rank or score chemicals based on their intrinsic hazards to human/environmental health
- Hazard identification based on:
 - 10 Human Health criteria
 - 8 Environmental Health criteria
- Scoring is done using a “stoplight” approach

Chemical Profile Colors

- **Green**
 - Little or no hazard
- **Yellow**
 - Low to moderate hazard
- **Red**
 - High hazard
- **Grey**
 - Incomplete HH or EH data

Human Health Criteria

- Carcinogenicity
- Disruption of Endocrine System
- Mutagenicity
- Reproductive Toxicity
- Teratogenicity
- Acute Toxicity
- Chronic Toxicity
- Irritation of Skin/Mucous Membranes
- Sensitization
- Other (e.g., skin penetration potential, flammability, etc.)

Environmental Health Criteria

- Aquatic toxicity
 - Fish toxicity
 - Daphnia toxicity
 - Algae toxicity
- Bioaccumulation (BCF, log Kow)
- Climatic Relevance/Ozone Depletion Potential
- Persistence/Biodegradation
- Organohalogen content
- Other (e.g., Water Danger Score, Toxicity to Soil Organisms, etc.)

Human Health Cut Off Values

Criterion	Green	Yellow	Red
Carcinogenicity	Not known or suspected of being carcinogenic	Not classifiable as a human carcinogen	Known or suspected carcinogen
Disruption of Endocrine System	Not known or suspected of being an endocrine disruptor		Listed as a known/suspected endocrine disruptor supported by peer reviewed science
Mutagenicity	Product has been tested and is not mutagenic to eukaryotes	Product has been tested in prokaryotes only and is negative	Product has confirmed positive mutagenicity test(s)
Reproductive Toxicity	Not known or suspected of being a reproductive toxin		Substance has positive test results or is listed as a reproductive toxin
Teratogenicity	Not a known or suspected teratogen	Not teratogenic as long as MAK value observed	Positive teratogenic test results or listed as a known or suspected teratogen
Acute Toxicity (oral)	Oral LD50 > 2000 mg/kg	2000 mg/kg > Oral LD50 > 200 mg/kg	Oral LD50 < 200 mg/kg
Acute Toxicity (inhalative)	LC50 > 4000 mg/m3	4000 mg/m3 > LC50 > 400 mg/m3	LC50 < 400 mg/m3
Chronic Toxicity	Low chronic toxicity (e.g., NOAEL > 100 mg/kg)	Moderate chronic toxicity	High chronic toxicity
Sensitization	Not sensitizing to skin or airways (either proven via experience or test)	Equivocal sensitization data	Listed as a skin or airway sensitizer or has tested positive in sensitization test(s)
Irritation of Skin/Mucous membranes	Mild or no irritation	Mild to moderate irritation	Severe irritation, risk of severe burns or serious damage to eyes

Environmental Health Cut Off Values

Criterion	Green	Yellow	Red
Fish Toxicity	LC50 > 100 mg/L (96 hr)	100 mg/L > LC50 > 10 mg/L	LC50 < 10 mg/L
Daphnia Toxicity	LC50 > 100 mg/L (96 hr)	100 mg/L > LC50 > 10 mg/L	LC50 < 10 mg/L
Algae Toxicity	EC50 > 100 mg/L (96 hr)	100 mg/L > EC50 > 10 mg/L	EC50 < 10 mg/L
Persistence/ Biodegradation	T1/2 < 10 days Readily biodegradable (based on OECD tests)	10 days < T1/2 < 30 days in air, 50 days in soil Ultimately biodegradable but not readily	Not biodegradable
Bioaccumulation	BCF < 100	100 < BCF < 1000	BCF > 1000
Content of Halogenated Organic Compounds	Substance does not contain any organohalogens in concentrations > 0.01%		Substance contains organohalogens in concentrations > 0.01%
Climatic Relevance/ Ozone Depletion	Not listed as a class 1 or 2 ozone depletor		Listed as a class one or two ozone depletor

Rolling Chemical Profiles up to Material Assessments

- Identify all ingredients and their functions
- Complete Chemical Profile for each ingredient
- Understand end state of each ingredient
- Apply “Contextual Filter” to each input to determine hazard relevance
- Assess and score material/mixture using same “stoplight” approach

Nylon 6 Assessment



Nylon 6 Material Assessment Report

MATERIAL ASSESSMENT SUMMARY					
Material Name	Comments				Assessment
Nylon 6	The potential routes of exposure of carbon black as it exists in a polymeric material do not pose a risk to the user or recycler of the material. Therefore the red flag for this ingredient is changed to a yellow assessment as used in this material. While there is very little recycled content in this material, glass filled Nylon 6 can be mechanically, or chemically recycled and therefore is positioned to be a true technical nutrient.				GREEN
INGREDIENT ASSESSMENT SUMMARY					
Ingredient Name	CAS No.	Function	Concentration	Profile	Assessment
Nylon 6	25038-54-4	Base resin	>80%	Green	Green
Chopped Strand Fiberglass	65997-17-3	Reinforcement	15%	Yellow	Green
Sodium Stearate	822-16-2	Lubricant	<1%	Green	Green
Potassium Bromide	7758-02-3	Stabilizer	<1%	Yellow	Yellow
Copper Iodine	7681-65-4	Stabilizer	<1%	Green	Green
Carbon Black	1333-86-4	Pigment	<1%	Red	Yellow(1)
FOOTNOTES					
<ol style="list-style-type: none"> Carbon Black - The potential routes of exposure for carbon black as it exists in a polymeric material does not pose a risk to the user or recycler of the material. 					



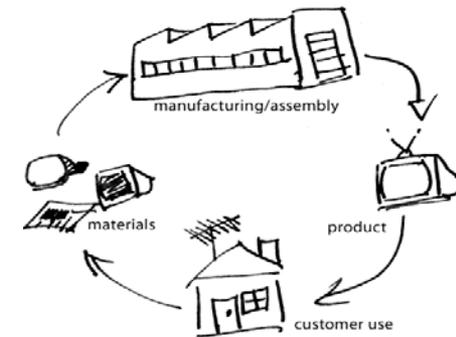
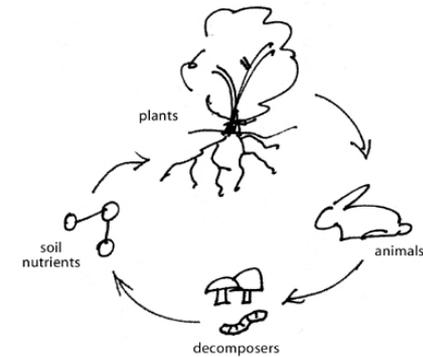
Product Overview

Structure	Part Number	Part Description	Generic Material (ie. Acetal, Nylon, Steel, Aluminum....)	Exact Material Specification (ie. Delrin 500, OMNI PA6/6/625, ASTM 1008/1010, 380 Aluminum)	Color	Color / Finish
xxxx	893446503	CYLINDER - BALL END	ACETAL	DELRIN 500 AL		
xxxx.1	801846511	SIDE RAIL, LH	ALUMINUM	A380 ALUMINIUM		PLASTIC MEDIA VIBRATORY FINISH
xxxx.2	860046501	AXLE	STL_CARBON	1008 CARBON STEEL		
xxxx.3	883046506	LINK AND BUSHING ASSEMBLY, SMM	MULTIPLE	N/A		
xxxx.3.1	892146505	BEARING - SHOULDER	ACETAL	DELRIN 500 AL		NATURAL
xxxx.3.2	860046500	AXLE	STL_CARBON	CARBON STEEL CASE HARDENED TO RC 60		COMMERCIAL ZINC TRIVALENT
xxxx.4	893246506	BLOCK - HINGE, RH	RESIN	LUBRIBLEND PA 6/6 GF 50		

2.0 Material Reutilization

...design with the end in mind

- Design that is truly reusable
- Biological nutrients – safely returned to the earth
- Technical nutrients – unending reuse
- Truly closed loops



3.0 Energy

- What is the energy intensity of a material's or product's creation?
- What is the quality of energy required for its creation?
- What energy sources are used in its creation, distribution, use, and value recovery processes? (Renewables vs. non-renewables.)
- What is your plan for supplying all production energy needs from renewables?

4.0 Water

- Water stewardship
- Recognize water flows
- Water conservation initiatives
- Improve the quality of water discharges

5.0 Social Fairness

- Corporate ethics
- Fair labor
- Self assessment
- Making a difference

Summary of Certification Levels

BASIC

- All materials inventoried and assessed
- No “Black List” substances present
- Must be developing strategy to phase out problematic substances
- Defining product for BN/TN

Summary of Certification Levels

SILVER

- Does NOT mean material chemistry fully optimized
- Must have strategy/timeline for optimizing problematic chemicals
- Beginning to develop strategy for recovering/cycling product
- Understand energy footprint and have strategy to increase % of renewables
- Water stewardship and social fairness policies publicly available

Summary of Certification Levels

GOLD

- Product chemistry optimized
- Manufacturer playing larger role in product recovery/cycling
- Energy for final assembly/manufacture at least 50% renewable
- Water audit done on manufacturing facility(ies)
- Fair labor self audit

Summary of Certification Levels

PLATIUM

- Material chemistry fully optimized
- Product recovered and recycled/remanufactured into product of equal or higher value
- Total energy footprint of product at least 50% renewable
- Innovations around water use/quality of discharge
- Third party social accreditation – all suppliers meet Silver level social equity criteria



Steelcase®





Shaw[®]
Where Great Floors Begin[®]

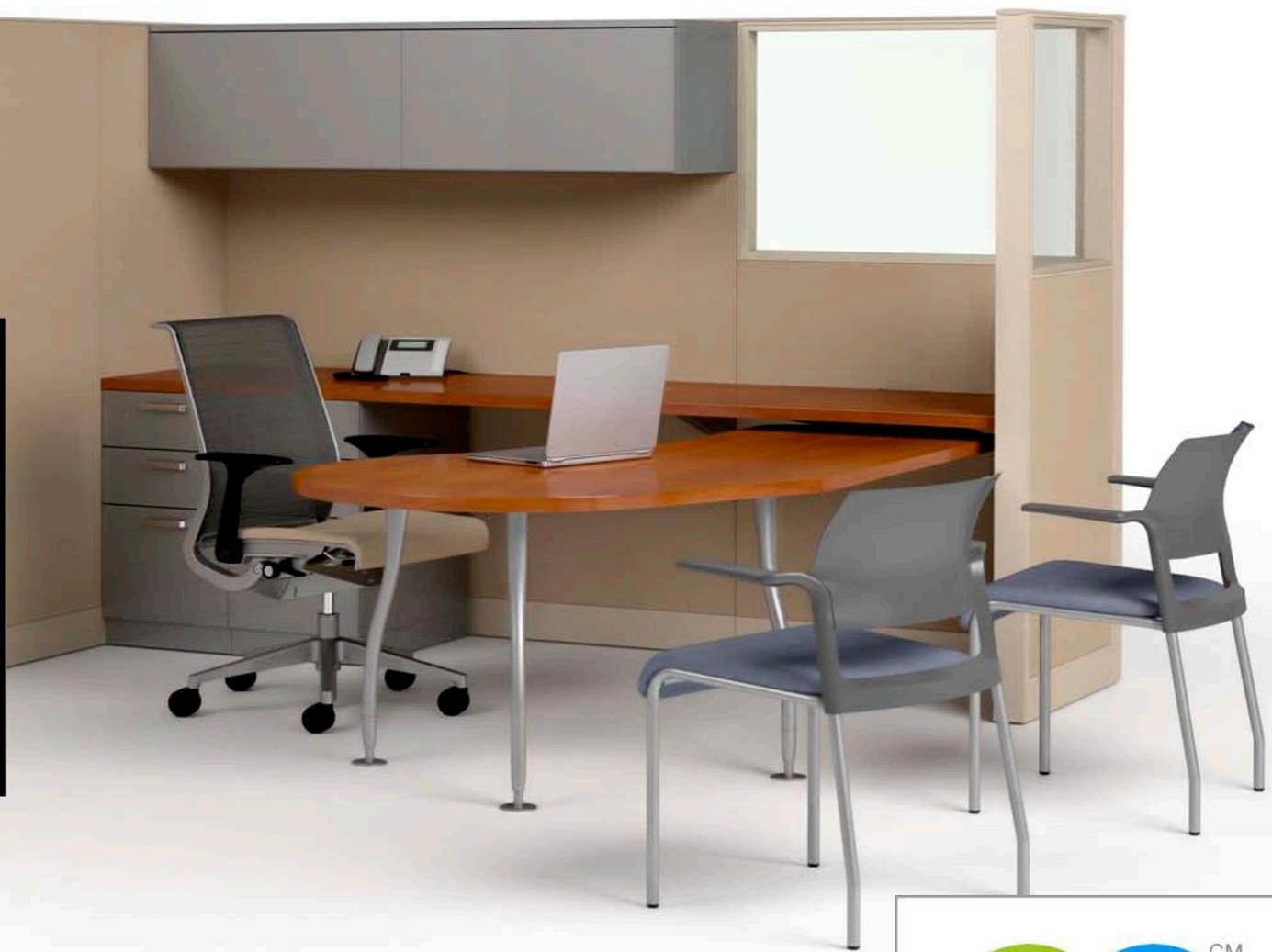


IceStone[®]

DURABLE SURFACES MADE OF RECYCLED GLASS & CONCRETE



Steelcase[®]



Cradle to Cradle AA Process

- Required under the product certification program for all products with one or more RED assessed materials
- Collaborative process with manufacturer and supplier chain
- Flexible timeline for implementation
- Continuous improvement, NOT perfection, is the goal

Cradle to Cradle AA (cont.)

PRIORITIES:

- Toxicity
- Nutrient reuse potential of material

AA Example - MechoShade



-
- Original fabric RED due to PVC coextrusion over PET core
 - Original fabric not recyclable due to PVC contamination
 - New fabric TPO over PP core but still RED due to non-PBDE based BFR
 - New fabric 100% recyclable

AA Example – Shaw Carpet



Initial carpet tile

- N 6.6 face fiber
- PVC backing with Sb2O3 FR synergist

Optimized version of same carpet tile

- N6 face fiber
- TPO backing with mineral based FR



*We do not inherit the earth from our ancestors,
We borrow it from our children*