

# **Introduction to the Cradle to Cradle Design<sup>SM</sup> Framework**

Version 7.02

By

McDonough Braungart Design Chemistry



# Introduction to the Cradle to Cradle Design<sup>SM</sup> Framework

*The world will not evolve past its current state of crisis  
by using the same thinking that created the situation.*  
– Albert Einstein

"...a unified philosophy that—in demonstrable and practical ways—is changing the design of the world."  
– *Time*, 2 Feb. 1999

## 1. Introduction

The Cradle to Cradle Design<sup>SM</sup> Framework is a revolutionary approach to the redesign of human industry based on the conviction that thoughtful design, mirroring the safe, regenerative productivity of nature, can create an industry that is *sustaining*, not just sustainable. In short, the Cradle to Cradle Design Framework embraces the pursuit of *maximum value* (economic, ecological, and social) through the practice of intelligent design. It is the foundation of an emerging world in which all human industry is designed to celebrate interdependence with other living systems, transforming the making and consumption of things into a regenerative force.

## 2. The Cradle to Grave Legacy

The Industrial Revolution launched a period of human endeavor in which the development of new technologies improved the lives of many of the world's people. Advances in the affordability of energy and transportation, mechanization and mass production, and communications and information technologies have yielded a host of benefits for industrialized societies.

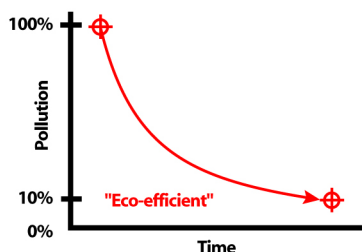
Yet for all the good that came with the Industrial Revolution, its unintended negative consequences are becoming more apparent all the time.

- Pollution of air, water, and soil from billions of pounds of waste
- Reduced cultural and biological diversity
- Complex environmental and health regulations
- Prosperity measured by activity (GNP, etc.), not legacy
- Degradation of traditional social fabric
- Wide-spread poverty
- Tons of valuable materials lost each year to incineration or landfills
- Production of highly dangerous and persistent materials
- Reduction of nature's capacity to maintain healthy, fertile ecosystems.

### Eco-Efficiency: Fine Tuning the System

Environmentalists and business leaders sensitive to this legacy have tried to limit the consequences of industrial production by retrofitting the systems of industry to reduce their harm. Some of their aims include:

- Releasing less waste into the air, water and soil
- Meeting or exceeding environmental regulations
- Sending less material to landfills
- Making fewer dangerous materials
- Depleting natural resources more slowly.



The aims of eco-efficiency are essentially to become "less bad"—for instance, beginning with a system that is 100% "bad", and seeking to become only 10% bad.

These goals have been most visibly articulated in the widely embraced business strategy of the 1990s, *eco-efficiency*. As admirable as its goals may be, eco-efficiency does not change the story. At its heart, eco-efficiency is a guilt-driven agenda that takes for granted—even institutionalizes—the antagonism between nature and industry.

### 3. A New Story: Cradle to Cradle Design

Cradle to Cradle Design offers a compelling alternative. It rejects the assumption that human industry inevitably destroys the natural world. Instead, Cradle to Cradle Design embraces abundance, human ingenuity, and positive aspirations.

Imagine an industrial system that:

- Purifies air, water, and soil
- Retains valuable materials for perpetual, productive reuse
- Measures prosperity by natural capital productively accrued
- Requires no regulation
- Creates positive emissions
- Celebrates an abundance of cultural and biological diversity
- Enhances nature's capacity to thrive
- Grows health, wealth, and useful resources
- Generates value and opportunity for all stakeholders.

Such a system, modeled on the natural world's abundant creativity, can solve rather than alleviate the problems industry currently creates, allowing both business and nature to thrive and grow.

#### Eco-Effectiveness: Following Nature's Design Principles

By pursuing a vision of industry that does not damage ecosystems or social systems, Cradle to Cradle Design moves beyond the "less bad" aims of eco-efficiency. It proposes, instead, a new strategy called *eco-effectiveness*.

By observing healthy natural systems we can see three basic principles of eco-effectiveness, modeled on the design principles of nature: *waste equals food*, *use current solar income*, *respect diversity*. By learning from nature's 'design principles,' eco-effective design conceives industrial systems that emulate the healthy abundance of nature.

**Waste equals food.** The processes of each organism engaged in a living system contribute to the health of the whole. One creature's "waste" is nourishment for another.

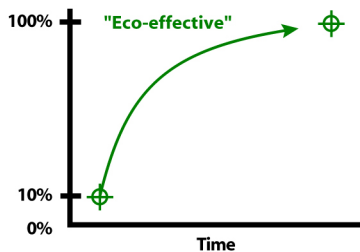
**Use current solar income.** Simply put, a cherry tree manufactures food using sunlight, an elegant, effective system that uses the earth's one perpetual source of energy income.

**Celebrate diversity.** Natural systems thrive on complexity. Instead of distilling Darwin's ideas into the "survival of the fittest," Cradle to Cradle Design sees greater significance in Darwin's identification of nature's profusion of niches (survival of the 'fittingest').

### 4. Conceiving Cradle to Cradle Products: The Intelligent Product System

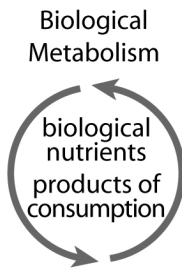
The key principles of eco-effective design were first systematically outlined in the Intelligent Product System (IPS), developed and articulated by Michael Braungart and his colleagues at EPEA. IPS provides a framework for cradle-to-cradle product conception and material flow management.

Just as in natural systems one organism's 'waste' becomes nutrients for another, IPS utilizes effective nutrient cycles in the realm of human industry.



Eco-Effectiveness defines a positive agenda, envisioning a positive system as the goal—starting, for instance, acknowledging that something is only 10% positive, and working toward 100% positive.

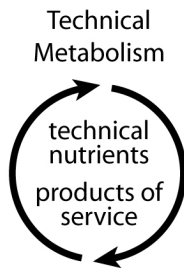
IPS recognizes two metabolisms within which materials flow as healthy nutrients.



**Biological Metabolism**

Materials that flow optimally through the biological metabolism are called *biological nutrients* (e.g. the nitrogen cycle). As defined for cradle-to-cradle products, biological nutrients are biodegradable (or otherwise naturally degradable) materials posing no immediate or eventual hazard to living systems that can be used for human purposes and be safely returned to the environment to feed ecological processes.

Products conceived as biological nutrients are called *products of consumption*. They are designed for safe and complete return to the environment to become nutrients for healthy living systems.



**Technical Metabolism**

A *technical nutrient* is a material, frequently synthetic or mineral, that remains safely in a closed-loop system of manufacture, recovery, and reuse (the technical metabolism), maintaining its highest value through many product life cycles.

Technical nutrients are used in *products of service*, which are durable goods that render a service to customers. The product is used by the customer but owned by the manufacturer, either formally or in effect. The *product of service* strategy is mutually beneficial to the manufacturer and the customer. The manufacturer maintains ownership of valuable material assets for continual reuse while customers receive the service of the product without assuming its material liability. The manufacturer or commercial representative of the product also fosters long-term relationships with returning customers through many product life cycles.

**Unmarketables**

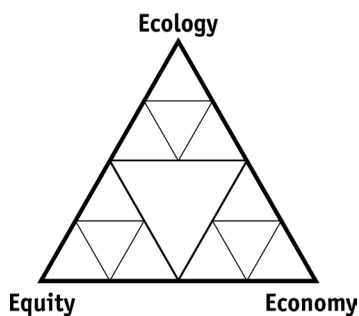
Materials or products that have lost their commercial value, often becoming hazardous waste, are *unmarketables*. They are not designed for reintroduction to healthy technical or biological metabolisms, or stored without environmental risks.

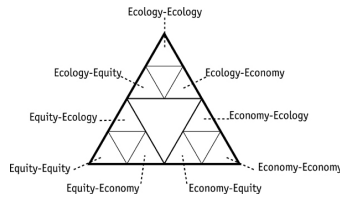
**5. Fractal Ecology: Value and Opportunities**

In our infinitely interconnected world, Cradle to Cradle Design sees an abundance of opportunity to create value throughout the wide spectrum of human concerns anchored by economy, ecology and equity.

This concept, which we call Fractal Ecology, is embodied in the fractal triangle. Developed as a conceptual, discursive tool for analyzing and understanding opportunities to grow value, the fractal triangle shows how, at any level of scrutiny, each design decision has an impact throughout the spectrum. The goal is not to *balance* economy, ecology and social equity but to optimize and *maximize* value in all areas of the triangle through intelligent design.

Here are some examples of questions designers might to employ Fractal Ecology in designing an eco-effective product. Moving clockwise, beginning in the lower right corner one could inquire:





***Economy-Economy***  
Can we make and sell the product at a profit?

***Economy-Equity***  
Is the product contributing to the wider economic health of the community?

***Equity-Economy***  
Is the product or process achieved while providing fair benefits and wage practices?

***Equity-Equity***  
Is it improving the quality of life of all stakeholders?

***Equity-Ecology***  
Is it enhancing stakeholders' health and safety?

***Ecology-Equity***  
Is the product and production safe for local and global communities and ecosystems?

***Ecology-Ecology***  
Is it creating healthy habitat?

***Ecology-Economy***  
Is it making effective use of resources?

***Economy-Ecology***  
Is it making efficient use of resources?

Of course, any point in the fractal triangle could yield many alternative questions, each of which presents an opportunity for creating value. Together, they signal the possibility of acting with positive intentions across a wide spectrum of concerns.

## 6. The Business Value of Cradle to Cradle Design

Some of the benefits and opportunities presented by designing products as biological and technical nutrients include the following.

- A new perspective, fostering design innovation
- Strong, lasting customer relationships
- Valuable materials perpetually put to valuable use
- Additional means for understanding and measuring progress
- Natural resources replenished through safe, productive commerce
- Chemicals, materials, and processes designed for health and perpetual recyclability
- Customers receiving valuable services without material or toxic liability
- Risks effectively managed by designing them out of products and systems.

## 7. Put to Practice: The Cradle to Cradle Design Protocol

The Cradle to Cradle Design Framework incorporates nature's cyclical material model into all product and system design efforts, using the Cradle to Cradle Design Protocol (the Protocol).

The Protocol is a working, results-oriented method for evaluating and (re)designing products and processes. This parallel process phases out undesirable substances and replaces them with preferable ones.

### Human and Ecological Health Assessment

The Protocol is used to assess materials' human and ecological health according to the following criteria:

Priority Human Health Criteria (known or suspected):

- carcinogenicity
- endocrine disruption
- mutagenicity (accidental and/or engineered)
- reproductive and developmental toxicity (teratogenicity).

Additional Human Health Criteria:

- acute toxicity
- chronic toxicity
- irritation of skin/mucous membranes
- sensitization
- other (e.g., skin penetration potential, flammability, etc.).

Ecological Health Criteria:

- bioaccumulation
- climatic relevance
- content of halogenated organic compounds
- fish toxicity
- algae toxicity
- daphnia toxicity
- heavy metal content
- persistence/biodegradation
- other (e.g., water danger list, toxicity to soil organisms, etc.)

Natural Systems Equilibrium Criteria:

- global warming potential
- ozone depletion potential.

**Value Recovery Potential**

To recover value and maintain materials in closed loops, materials either return safely to soil or are recyclable as a technical nutrient. Evaluation of the value recovery potential of a material is based on the following considerations:

- Is it technically feasible to compost or recycle the material?
- Does a recycling or composting infrastructure exist for the material?
- What is the resulting quality of the recycled material or compost?
- Have the materials and products been designed to facilitate post-use value recovery?

**Energy Profile**

As industry moves toward renewable energy sources based on current solar income, materials and products can be evaluated for their effective use of energy. This process includes the following considerations:

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