Cradle-to-Cradle

Rethinking Design

Jessica B. Smith

This paper introduces cradle-to-cradle design philosophy and proposes a new system for engineering, production, and distribution of products such that industry works with nature instead of against it. Many companies have already explored this concept and have been able to gain and maintain a competitive advantage, increase profitability, and help the environment.

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CRADLE-TO-CRADLE: RE-THINKING DESIGN

Executive Summary

Since the first Industrial Revolution, there has been a relentless attempt to impose universal design solutions which has manifested an underlying and dangerous assumption that nature should be overwhelmed, and industry has gone to great lengths to make these solutions “fit”. The result of these careless actions will ultimately be the destruction of life as we know it. Instead of adopting a strategy of eco-efficiency to temporarily address these issues which simply prolongs the period in which materials reach their “grave”, individuals as well as industries are commissioned to re-engineer the design process so that a cradle-to-cradle philosophy is achieved. The cradle-to-cradle framework is modeled after natural processes and approaches the idea of sustainability from a design perspective, proposing a closed-loop cycle of material flows so that there is no concept of waste. Dr. William McDonough and Dr. Michael Braungart advocate that the traditional approaches to sustainability only make circumstances ‘less bad’, which could be worse than doing nothing at all. With the help of leaders such as McDonough and Braungart and governments stepping in, some individuals and industries have begun to lead the way to this transition. However, if we are to make the most with what we have been so greatly commissioned with the responsibility of taking care of instead of destroying it, we all must work together as soon as possible.

CRADLE-TO-CRADLE DESIGN

The Cradle-to-Cradle framework is a science- and values-based vision of sustainability that describes a positive, long-term goal for engineers: the design of a commercially productive, socially beneficial, and ecologically intelligent industrial system. This approach to sustainability is from a design perspective, which makes apparent the need for a fundamental, conceptual shift away from the design of current industrial systems, which generates toxic, one-way, “cradle-to-grave” material flows, toward a “cradle-to-cradle” system powered by renewable energy, in which materials stream in a harmless, regenerative, closed-loop cycle. This new approach to design and manufacturing has also been called ‘Sustainability 2.0’ because of the innovative nature of this concept. This framework posits a new way of designing human systems to ultimately solve, rather than temporarily alleviate, the human-created conflicts between economic growth and environmental health that result from poor design and market structure (W. B. McDonough).

Doing the right things, the right way without perspective or guiding principles can ultimately become an efficient pursuit of the wrong goals. Subsequently, engineers can be headed toward positive ends yet be undermined by tools that will never get them where they really need to be. Dr. William McDonough introduces the Principles of Green Engineering, which provide guidance for realizing this long term goal that is convincingly achievable. These principles suggest ways in which engineers and designers can pursue optimized, cradle-to-cradle products and systems. The greatest investment of time, money, or other resources often comes from redefining the problem itself. (W. B. McDonough)

The Foundations of Cradle-to-Cradle Design

The Cradle-to-Cradle Framework identifies the natural world’s operations system as a perfect model for human design. This model attempts to utilize the effectiveness provided by nature; free energy from the sun, which interacts with the geochemistry of the earth’s surface to sustain productive, regenerative biological systems in which absolutely no waste is produced. The Cradle-to-Cradle Framework advocates three key design principles which are found in natural systems and can be used by humans in the design process: (1) *Waste Equals Food,* (2) *Use Current Solar Income,* (3) *Celebrate Diversity.* (W. B. McDonough)

Waste Equals Food:

There is no concept of *waste* in nature because the processes of each life form add to the health of the whole ecosystem. One organism’s waste is food for another which creates an infinite flow of nutrients in the cradle-to-cradle cycles of birth, decay, and rebirth (W. B. McDonough). In their book Cradle-to-Cradle, William McDonough and Michael Braungart use a cherry tree to illustrate this point. They describe how nature operates according to a system of nutrients and metabolisms, such as the cherry tree which makes many blossoms and fruit to germinate and nurture that life form along with many other organisms. Although the tree produces many blossoms that will never become fruit, they are far from useless. When the extra blossoms fall to the ground and decompose, they feed various organisms and microorganisms while enriching the soil for future growth. As animals and humans exhale carbon dioxide, this tree along with all other plants take it in and use it for their own growth while emitting oxygen which is used by the animals and humans. This process is illustrated in every one of nature’s systems where all of the Earth’s major nutrients—carbon, hydrogen, oxygen, nitrogen—are cycled and recycled to create an effective environment where *waste equals food* (W. B. McDonough 92).

If our systems continue to contaminate the Earth's biological mass which is finite in nature and production and consumption are restrained, the Earth will literally become a grave. McDonough and Braungart describe the two distinct metabolisms that are found on our wonderful planet. The first of which is the *biological metabolism*, or the biosphere also known as the cycles of nature. The second is the technical metabolism, or the technosphere which is the cycles of industry, including harvesting resources from natural places to be used in industry. They argue that the right design will support these two metabolisms, forever providing nourishment for something new. The authors propose that products can be composed of materials that biodegrade and become food for the biological cycles, or be made of technical materials that stay in closed-loop technical cycles to continually circulate as valuable materials for industry. Great care must be taken to ensure that these two metabolisms do not contaminate one another. They suggest the idea of *worry-free packaging* to explain the process of biological metabolism which can safely decompose or be gathered and used as fertilizer. For instance, a paper ice cream cone wrapper could contain a seed that will, once discarded, grow into a plant to further nourish the environment. There is absolutely no reason why packaging should last decades or centuries past the life of the product it contained unless, of course, it can be used over and over again. A technical nutrient is a material or product that is designed to go back into the technical cycle. For instance, a television contains 4,360 chemicals, many of which are valuable nutrients for industry that are wasted and lost forever when the television ends up in the landfill. By isolating technical nutrients from biological nutrients allows them to be *upcycled* which retains the highest quality in a closed-loop industrial cycle. (W. B. McDonough 103-110)

Figure 1: Architecture and Life Cycle Analysis: Implementing Cradle-to-Cradle Thinking (Goodbun)

In describing the notion of a technical nutrient, it is important to understand the concept of a *product of service* which assumes that products are reconceived as *services* people want and enjoy, instead of assuming all products are to be bought, owned, and disposed of by "consumers". In this situation, users of these products would buy the service for a *defined user period*. For example, instead of purchasing a television, one would purchase ten thousand hours of TV viewing. This eliminates the customer paying for the complex materials that they will not be able to use after the products current life is over. The consumer will simply upgrade after the useful life of the product is over and the manufacturer takes the product back to break it down and use the complex materials as *food* for new products. Under this scenario, consumers could indulge their hunger for new products as often as they wish, without feelings of guilt, and industry could encourage them to do so, knowing that both sides are supporting the technical metabolism process. The irony involved with the way we currently design our products as durable as possible lies in the fact that future generations do not want to have to contend with our products that were designed to last forever, but not be useable forever. This process has many advantages, including no useless and potentially dangerous waste would be produced, manufacturers would save billions of dollars in valuable materials, and the extraction of raw materials would be diminished (W. B. McDonough 109-113).

Use Current Solar Income

Virtually all of nature's industries rely on energy provided from the sun, which can be viewed as a form of current, constantly renewing income. Cradle-to-Cradle systems can tap into current solar income to thrive on the energy produced by the sun, much as the living things of nature. This can be achieved by using direct solar energy collection or passive solar processes, such as *daylighting*, which makes effective use of natural light. Solar income can also be retrieved through wind power-thermal flows fueled by sunlight. (W. B. McDonough)

Celebrate Diversity

Natural systems thrive on diversity, given that each healthy ecosystem is a complex community of living things which has developed a unique response to its surroundings that works together with other organisms to sustain the system. Each life form fits into its place and only the fittest survive. However, a long-term perspective is required since the introduction of an invasive species will enhance diversity but will eventually destroy diversity over time. As for human designs, optimal sustainable cradle-to-cradle solutions are designed from and fit within local natural systems, taking into account both the distant effects of local actions and the local effects of distant actions. Instead of offering *one-size-fits-all* solutions that are characterized in conventional engineering, products should be designed in such a way that celebrates and supports diversity (W. B. McDonough). Companies need to get away from a universal design solution, in which the product is designed for a *worst-case scenario* so that it will always operate with the same usefulness everywhere. A classic example of where this method of design is detrimental to the environment can be found in mass-produced detergent. Soap manufacturers produce one detergent for their entire distribution area, despite the fact that different areas need different amounts of detergent depending on the softness and/or quality of the water. Manufacturers simply add more chemical force to wipe out the conditions of circumstance, completely ignoring the fact that much of the runoff containing this soap runs off into bodies of water which come into contact with and harm fish. In effect, human industry's relationship with the natural world is revealed in the process of designing for the worst-case scenario—the incorrect assumption that nature is the enemy (W. B. McDonough 28-30).

WHY CHANGE?

Asthma is now the most prevalent children's disease, with 40% of children suffering from allergies, compared to only 2-3% just a few decades ago (Steffen). Relatively new research on particulates—microscopic particles released during incineration and combustion processes, such as those in power plants and automobiles—show the lasting and damaging effects they cause to our lungs. In 1995, a Harvard study determined that around 100,000 people die every year in the United States alone as a result of these tiny particles. Not to mention, the legislation put into place to reduce the amount of this toxin did not take effect until 2005 (W. B. McDonough). As we all know, the consistent burning of fossil fuels has prevented the heat produced by these gases from escaping, causing the most severe form of climate change the world has ever seen. Global warming has immediate and lasting detrimental effects, which we may never be able to predict. According to NASA, we have experienced two of the hottest years on record within the past decade, 1998 and 2005. Top researchers at MIT report that there has been a 100% increase in the intensity and duration of severe storms such as hurricanes and tornadoes since the 1970s. As the worldwide temperature continues to rise, glaciers continue to melt, causing sea levels to rise, wiping out many of the subtropical islands of the world (The Global Warming Overview). Unfortunately, there are many more compelling statistics that illustrate the urgency required to address these issues.

"WHY BEING 'LESS BAD' IS NO GOOD"

The Cradle-to-Cradle Framework does not approach sustainability as it is typically defined. Sustainability, or eco-efficiency, has been popularly defined in the industrial sector as "doing more with less", or "recycling the human footprint to minimize the troubling symptoms of environmental decline. Conventional sustainability from an engineering perspective too often advocates that the machines of industry be retrofitted with cleaner, more efficient engines, but this is not a sufficient or long-standing goal. While this eco-efficiency approach may seem worthwhile, this traditional model of attempting to add more value to a good or service while using fewer resources and releasing less pollution is still failing to reach the point that our society must strive to achieve. The unsighted adoption of shallow environmental approaches without fully understanding their effects can be no better, and possibly worse, than doing nothing (W. B. McDonough). Unless a product's full life-cycle is taken into consideration, "landfills will continue to overflow with these 'sustainably-designed' products whose usefulness has come to an end," says Sarah Fister Gale in GreenerDesign (Rich).

Finding markets to *reuse* or *relocate* waste will make industries and customers feel like they are doing their part to protect the environment because the piles of waste appear to go away. However, most of the time this waste and the toxins they produce are simply transferred to another place. This also applies to composting sewage into fertilizer, or feed for animals, which is the case in many underdeveloped nations. Unless the materials are specifically designed to ultimately become safe 'food' for nature, even composting can present disastrous effects. (W. B. McDonough 55-56)

Recycling=Downcycling

Recycling also illustrates how the best intentions can be devastating because the concept fails to incorporate a long-term view and goal. Most recycling is actually *downcycling*, that is, it reduces the quality of a material over time. For instance, when plastics other than those found in soda and water bottles are recycled, they are mixed with different plastics to produce a hybrid of lower quality, which will never become the same product again. This is often the case when metals are downcycled. For example, when a car is melted down to be *recycled,* the high tensile steel is mixed with other car parts, including copper from the cables, and the paint and plastic coatings. These materials in effect lower the recycled steel's quality and more high-quality steel must be added/wasted to make the hybrid strong enough for its next use. What is worse is the fact that rare metals, such as copper, manganese, and chromium as well as other items of value for the industry (paint, plastics, and other metals in auto industry) are now lost forever. Unfortunately, lost value and lost materials are not the biggest concerns.

Downcycling can actually increase contamination of the biosphere. Since downcycled materials are often less durable than their ancestors, more chemicals are often added to make them usable again. This presents a further concern, especially because people that buy and wear clothing made from recycled materials feel they are making an ecologically sound choice, when in reality they are wearing a product filled with chemicals that were never designed to lie next to human skin. Another perhaps unintended consequence of downcycling is that it is an expensive proposition for business. This is in part caused by the fact that recycling forces materials into more lifetimes than they were originally designed for, which results in a complicated conversion that eats up more energy and resources. Here again, we see how an ecological agenda becomes a burden for industry instead of a rewarding option. (W. B. McDonough 57-59)

Eco-efficiency vs. Eco-effectiveness

While being eco-efficient may reduce resource consumption and pollution in the short-term, it fails to address the profound design flaws of modern industry. Eco-efficiency simply addresses the problems without addressing the source, which inevitably institutes goals and employs practices that sustain a fundamentally flawed system (W. B. McDonough). While current strategies of eco-efficiency seek to reduce and minimize the unintended consequences of processes of production and consumption, the concept of eco-effectiveness demonstrates a positive agenda based on maximizing the ability of industry to truly support the natural systems surrounding it. By imitating the interdependent nature of biological systems, eco-effectiveness advocates that sustainability should not be concerned only with reducing the footprint of our activities on this planet, but rather transforming this footprint into a source of replenishment for those systems that depend on it (M. Braungart). Eco-effectiveness moves beyond zero emission approaches by focusing on the development of products and industrial systems that maintain or enhance the quality and productivity of materials through subsequent life cycles (M. M. Braungart).

There are many definitions that have been developed for eco-efficiency since its foundation in 1989. The World Business Council for Sustainable Development initially defined eco-efficiency as:

> “being achieved by the delivery of competitively priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life cycle to a level at least in line with the earth’s carrying capacity.”

Despite the many definitions of eco-efficiency, in this context, this concept can be said to encompass the dematerialization, increased resource productivity, reduced toxicity, increased recyclability(downcycling), and extended product lifespan(prolonging the period it takes the product to reach its grave). All of the strategies associated with eco-efficiency began with a common assumption of the linear, cradle-to-grave flow of materials through industrial methods. However, eco-efficiency is naturally at odds with long-term economic growth and innovation, subsequently failing to address the key issue of toxicity. In effect, eco-efficiency is simply a strategy for *damage management* and *guilt reduction* that only results in temporary relief, beginning with the assumption that industry is 100% *bad*, and pursues the goal of making it *less bad.* (M. M. Braungart)

Eco-Effective methodology contrasts with eco-efficiency in that it deals directly with the issue of maintaining or upgrading resource quality and productivity through many cycles of use, rather than just attempting to eliminate waste. Strategies of reduction and minimization are not even steps in the right direction unless they contribute to the ultimate aim of achieving cyclical material flow systems which ultimately uphold maximum product quality and productivity over time. If efficiency is defined as “doing things the right way, effectiveness can be defined as “doing the right things”. Efficiency alone has no significance because if industry is motivated by systems that are destructive, making them more efficient will not solve the problem. The goal of reducing material flows per product as eco-efficiency seeks to achieve, is only beneficial in the long run if the goal of closing material flows has been achieved first.

The following figure illustrates the fact that eco-efficiency begins with the assumption that industry is 100% bad, whereas eco-effectiveness starts with a vision of industry that is 100% good that supports and regenerates ecological systems, thereby enabling long-term economic growth and prosperity. It also demonstrates that the traditional assumption inherent in eco-efficiency approaches is flawed in its reasoning that industry and nature are natural enemies. This perspective is the basis for the concept of a *triple top line.* This concept is different from the traditional *triple bottom line* objectives which promote awareness within organizations of the environmental and social impacts of their activities that hopes to influence them to reduce their ecological footprint. Pursuit of a triple top line begins with an understanding that business value is originated in natural and social capital, and celebrates the potential synergies between economic, environmental, and social business objectives (M. M. Braungart).

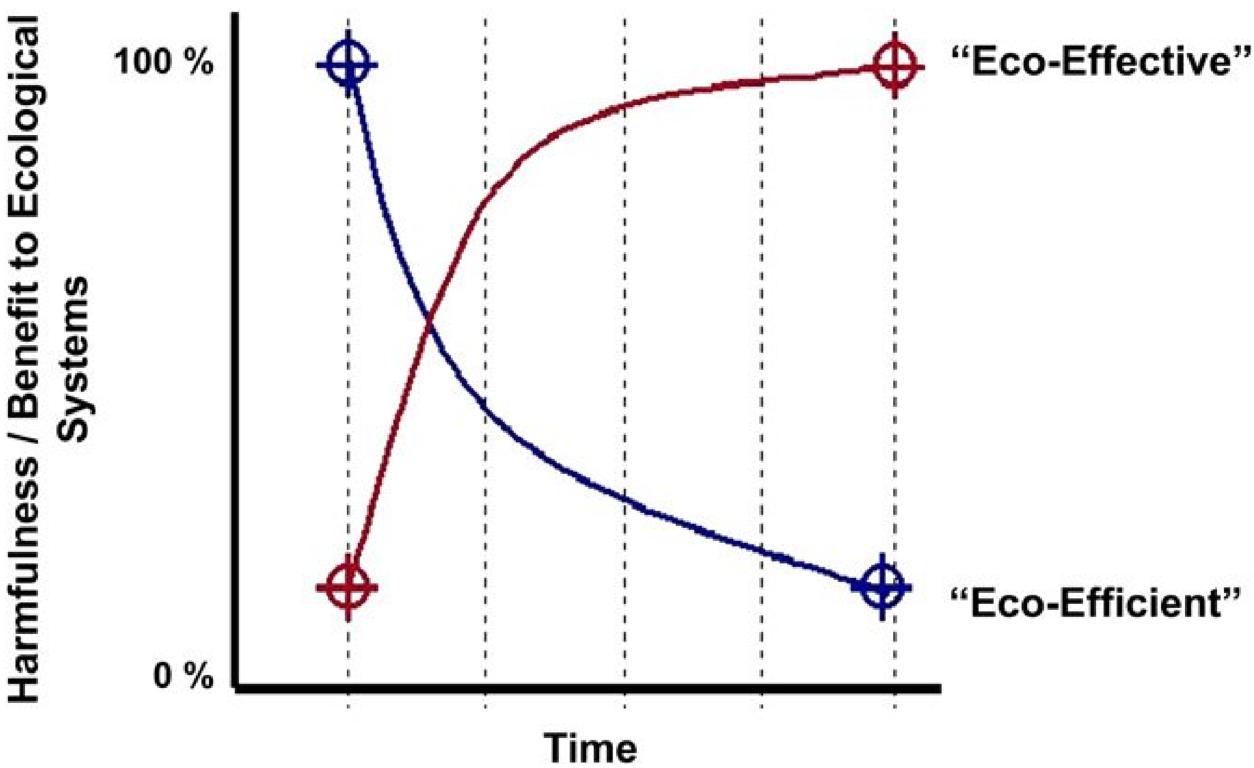

Figure 2: Eco-Effectiveness strives to generate an entirely (100%) beneficial impact upon ecological systems. (M. M. Braungart)

The following figure illustrates the process that is required for reengineering the design process:

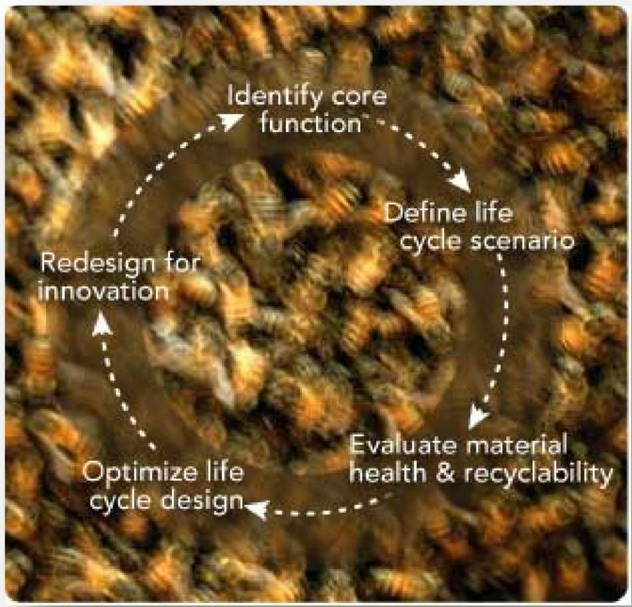

Figure 3: Architecture and Life Cycle Analysis: Implementing Cradle-to-Cradle Thinking (Goodbun)

PUTTING ECO-EFFECTIVENESS INTO PRACTICE

Any industry must have a clear understanding of a material or product's flow through various life cycle stages before beginning to transition to cradle-to-cradle design. GreenBlue is an organization that works with individuals, industries, and governments to realize the tremendous leveraging power of intelligent design to realize the maximum benefit provided by cradle-to-cradle products, services, and systems. The following is a chart provided by GreenBlue to illustrate the project development process. It demonstrates the greatest potential for realizing the positive benefits of a cradle-to-cradle perspective lies in the early design phases of project development, when opportunities that could affect the outcome of the project are the greatest and the resources committed to a solution are the smallest. (GreenBlue)

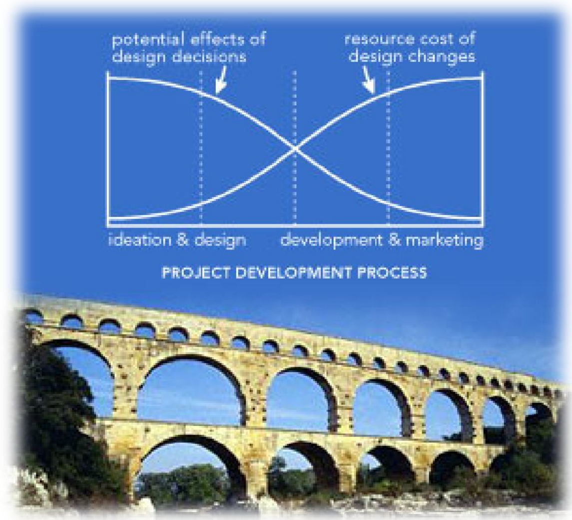

Figure 4: Project Development Process (GreenBlue)

McDonough and Braungart explain in five points how companies can most effectively adopt cradle-to-cradle practices.

1. *Get "free of" known culprits*

The first obvious step that industry as well as individuals should take toward becoming eco-effective is to turn away from material that is widely recognized as being harmful. However, this is only the first step. After removing the harmful toxin, great caution should be used to ensure that once the product is "free of" the known harmful culprit, something worse does not take its place. The important consideration is that simply being free of one thing does not necessarily make the product healthy and safe. (W. B. McDonough 166-168)

2. *Follow informed personal preferences*

In reality, decisions many times boil down to two alternatives that are both less than ideal. When choices are both equally bad, the chooser is likely to feel frustrated and helpless, which is another insightful reason redesign is critical. Until we reach the point of eco-effectiveness, ways do exist in which we can do the best with what we have to make better choices. One way we can make better choices in the meantime is to *prefer ecological intelligence* by making sure the products we use do not contain or support substances that are known to be harmful. We should also *prefer respect* for those that make the product, for the communities near where it is produced, for those who handle and transport it, ultimately for the consumer. Another element we can attempt to assess is to *prefer delight, celebration, and fun* which can accomplish more than just making the customer feel guilty or bad while decisions are being made. (W. B. McDonough 168-173)

3. *Creating a "passive positive" list*

We should go beyond existing and readily available information on the contents of a product, to ultimately conduct a detailed inventory of the entire palette of materials used in a given product and the substances emitted during production and use of that product. An *X-list* includes all of the most problematic substances that are commonly used in production—those teratogenic, mutagenic, carcinogenic, or otherwise harmful to human and ecological health. The *gray-list* contains problematic substances that are not in immediate need of a phase-out. A *P-list* is the positive/preferred list, including substances actively defined as healthy and safe for use. Considerations that must be made in order for a material to make the P-list include: acute oral toxicity, chronic toxicity, whether the substance is a strong sensitizer, whether the substance is a known carcinogen, mutagen, teratogen, or endocrine disruptor, whether the substance is suspected to be bio-accumulative, toxicity to water organisms, biodegradability, potential for ozone-layer depletion, and whether all by-products meet the same criteria. (W. B. McDonough 173-177)

4. *Activate the positive list*

This is the point where individuals and industry stop trying to be "less bad" and determine how they can be *good.* The authors use a culinary example to illustrate this point; "you're no longer substituting ingredients—you've thrown out the recipe and start from scratch, with a basketful of tasty, nutritious ingredients that you love to cook with." (W. B. McDonough 177-178)

5. *Reinvent*

At this point, we are commissioned to recast the design assignment; in other words, do not just reinvent the recipe, we rethink the menu. For example, instead of creating a car that produces zero emissions, aim to design a car which releases *positive* emissions and generate other nutrious effects on the environment. (W. B. McDonough 178-180)

EXAMPLES OF CRADLE-TO-CRADLE BEST PRACTICES

Ford Motor Company

Henry Ford practiced an early form of upcycling when he had Model A trucks shipped in crates which became the floorboards of the vehicle when it reached its destination (W. B. McDonough 110). Ford Motor Company is continuing to pursue its founder's passion by building an automotive assembly plant at its historic Rouge River manufacturing complex in Dearborn, Michigan with a 10-acre green roof that cost-effectively filters storm water run-off. This type of facility connects employees to their surroundings, creates habitat and invites the return of native species, produces oxygen, and restores the landscape. This "living" roof effectively filters storm water run-off for $35 million less than the typical storm water management systems required to meet regulations. The soil and vegetation on the roof also provides extra insulation, protects the roof membrane from wear and thermal shock, contributes to mediating the urban heat island effect, and captures harmful particulates from the air. Rather than introduce synthetic materials or machinery to accomplish corporate goals, Ford is taking a step in the right direction to utilize the existing natural systems' processes and energy flows to accomplish these goals more effectively. Additionally Ford has developed the Model U with the help of MBDC, the first automobile to incorporate inherently safe, beneficial cradle-to-cradle materials into its design. Some of the inputs for this revolutionary car include polyester upholstery fabric; a technical nutrient made from safe chemicals and is capable of continuous recycling. The top is made from a corn-based biopolymer that may be composted after use. (W. B. McDonough).

Figure 5: Ford Rouge Factory's 'Living Roof' (Green Design-From Cradle to Cradle)

Nike

Another example of a company taking a stand to reduce their harmful footprint on the environment is Nike. This company is working with McDonough Braungart Design Chemistry (MBDC) to identify materials that meet or exceed the company's current emerging criteria for sustainable design. These components are then added to a growing list of materials that Nike will increasingly use in its products. The ingredients are either safely metabolized by nature's biological systems when the useful life of the product is over, or returned to industry to be used repeatedly to make new products. This company has been able to successfully phase out harmful polyvinyl chloride (PVC) from its products. Nike has also been influential in helping its suppliers to design next generation materials to be less hazardous and more sustainable (W. B. McDonough). One of the company's agendas is to tan leather without harmful toxins, so that it is no longer a monstrous hybrid and be safely composted after use. Nike is also testing a new rubber compound that will also be a biological nutrient that could also have a wide reaching impact on many industries.

Herman Miller

Commercial furniture producer Herman Miller also works with MBDC to better achieve cradle-to –cradle and has developed an interdisciplinary Design for Environment (DFE) team that executes materials assessments based on MBDC's protocol, which influences design goals through the company, which measures environmental performance and engages its supply chain in implementing design criteria. During the design process, the multi-faceted assessment analyzes materials for their human health and eco-toxicological effects, recyclability, recycled content and/or use of renewable resources, and product design for disassembly. The DFE team includes a chemical engineer who incorporates findings from assessments into an evolving materials database, and a purchasing agent who acts as a conduit and data source between the supply chain and Herman Miller's purchasing team. One of Herman Miller's engineers has said "getting a handle on supply chain issues from an environmental standpoint has also helped us get a handle on the organization and prioritization of materials." This strategy also ensures a consistent procurement of safe materials by involving both groups in the implementation of new design criteria (W. B. McDonough).

Recyclability

- Material is a technical or biological nutrient
- Material can be down-cycled
- Material can be incinerated for energy recovery
- Material is normally land filled

Recycled content % of total weight

- Post Industrial Recycled Content
- Post Consumer Recycled Content
- Renewable Content

Disassembly

- Component can be seperated with no dissimilar materials attached
- Disassembly tools can be used
- One person can disassemble the component in 30 seconds or less
- Material can be identified by markings

Figure 6: Herman Miller Design for Environment Assessment Criteria (W. B. McDonough)

McCool CarpetPlus Colortile

Another company that has experienced success with adapting a cradle-to-cradle philosophy into its production process is McCool CarpetPlus Colortile. This company has shown a commitment to preserving resources and ensuring the needs of future generations with its EcoChoice™ branded carpet. This innovative product is designed to utilize post-consumer carpet in a closed-loop process which allows nylon fibers to be recycled to continually make new carpet. As this nylon is collected, it is sent to Shaw's Evergreen Nylon Recycling Plant which utilizes a patented technology that converts the post consumer nylon into caprolactam, the basic building block of nylon fiber. It is then sent to a yarn extrusion plant and made into new Type 6 Nylon fiber which is used to manufacture EcoChoice™ carpet. When the carpet reaches the end of its useful life, the product can be brought back to the recycling facility so the process can start all over again. Furthermore, this company will make a donation to the National Arbor Day Foundation with every purchase of an EcoChoice™ branded product which will assist in the reforestation and rain forest preservation programs. With every dollar contributed, the Foundation will plant one seedling or preserve 250 sq. ft. of rain forest. The following illustration shows the process that the carpet material goes through in this innovative cradle-to-cradle system. (CarpetPlus Color Tile. Thinking ahead. Thinking green)

Figure 7: Thinking ahead. Thinking green. (CarpetPlus Color Tile. Thinking ahead. Thinking green)

The following figure is another, closer look at the materials and the process by which recycled carpet becomes new carpet without downcycling:

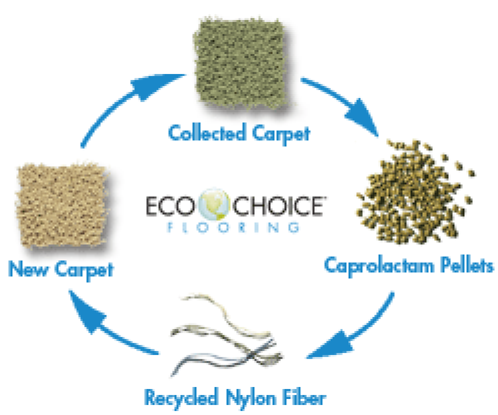

Figure 8: EcoChoice™ Flooring (CarpetPlus Color Tile. Thinking ahead. Thinking green)

GOVERNMENT INITIATIVES

Waste Electrical and Electronic Equipment Directive (WEEE Directive)

The WEEE Directive is the European Community directive on waste electrical and electronic equipment which became the law in February 2003, effectively setting collection, recycling, and recovery targets for all types of electrical goods. This directive imposes the responsibility on the manufacturer for the disposal of electrical waste and electronic equipment. The directive states that companies "should establish an infrastructure for collecting WEEE, in such a way that users of electrical and electronic equipment from private households should have the possibility of returning WEEE at least free of charge." The producers should be able to choose to fulfill this obligation individually or jointly with other manufacturers. The companies are also required to collect the waste in an ecologically-friendly manner (Parliament). So far, only a patchwork of compliance solutions has emerged throughout member states of the EU. To emphasize the importance of this directive, the Royal Society of Arts in the UK uncovered 'WEEE Man', a 21 foot tall sculpture made from 3.3 tons of electrical goods—the average amount of waste one UK individual produces in a lifetime (Waste Electrical and Electronic Equipment Directive)

The following is an illustration of the WEEE Directive's logo that is used to promote this initiative:

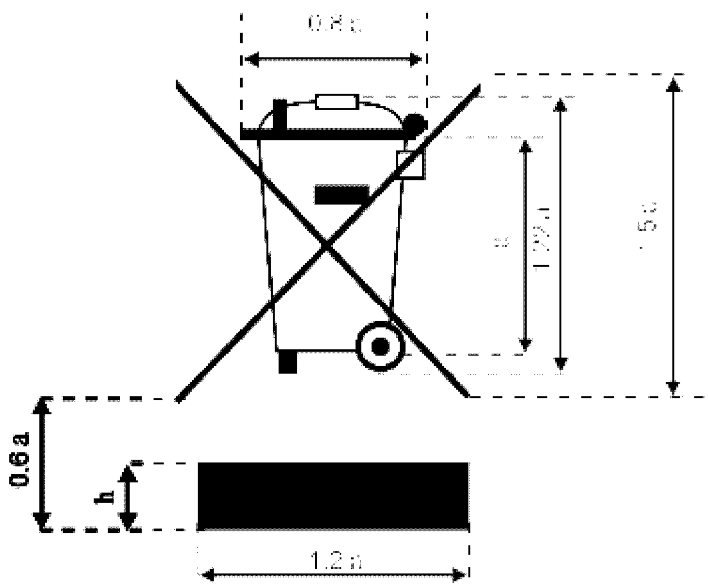

Figure 9: WEEE Crossed-out rubbish bin logo (Waste Electrical and Electronic Equipment Directive)

Restriction of Hazardous Substances (the "RoHS Regulations)

The main objective of the RoHS directive is to reduce the amount of restricted materials that are entering the waste stream. The National Measurement Office (NMO) is the UK Enforcement Authority for the restriction of the use of certain hazardous substances in electrical and electronic equipment. These regulations apply the EU Directive 2002/95 which bans the placing new electrical and electronic equipment on the market that contains more than the agreed levels of lead, cadmium, mercury, hexavalent chromium, polybrominated biphenyl (PBB), and polybrominated diphenyl ether (PBDE) flame retardants. This directive covers both household and professional electrical and electronic equipment. The RoHS directive came into effect on July 1, 2006. A website (http://www.rohs.gov.uk) has been developed which companies can visit to ensure that their products are in concordance with the law. The website outlines the due diligence that should be respected, describes enforcement procedures, and lists exemptions, events, and news. A decision tree is also provided which is intended to guide producers and other interested parties to determine whether or not their product falls within the scope of RoHS regulations (RoHS). The UK Restriction of Hazardous Substances Conformity Assessment Group (URCAG) is made up of parties interested in ensuring and assisting RoHS conformity of products. URCAG protocol defines the guiding principles for groups interested in assisting RoHS Conformity Assessment Bodies (NOMO Strategic Marketing & Design LLP).

CONCLUSION

Perhaps the greatest fallacy that the majority of people accept as true is the belief that the exhaustion of the Earth's resources will not happen in their lifetime, or their children's lifetime. Although no one knows for sure when we will tap the last of nature's goodness, if we continue our course of action, without altering our current diminution of the Earth's resources, the end of life as we know it will occur sooner than anyone could have ever imagined. Without a thorough understanding of the detrimental effects of our careless actions, there is no comprehension of how horrible the future may be and therefore, there is no motivation to change current habits, designs, and systems. We were given the great responsibility to look after and take care of nature and all its glory. We will never be without the resources we need if we take this great commission seriously, fully knowing the consequences if we fail. However, if we do not understand the cause-and-effect relationship that exists when we fail to take this responsibility seriously, if the exhaustion of resources does not occur in our lifetime, it will surely happen in our descendant's lifetime. Imagine how awful the world would be without the things you loved when you were a child; playing outside and smelling the fresh air, hearing the birds sing, seeing the flowers bloom in the spring and the leaves change colors in the fall, swimming in a lake, rolling around in the grass, going to the beach, playing in the snow, etc. It is up to *all* of us to ensure that future generations can enjoy the same things we do. Of course, we will not be able to successfully change habits and design solutions overnight. It will take everyone across the world working together to amend our course of action. It will take many years before cradle-to-cradle design solutions are adapted all over the world. However, if we all begin making small changes in the way we live every day, it will be a big step in the right direction.

Call to action!

The authors of Cradle-to-Cradle end one of the chapters of the book with a call to action that is very interesting and makes one really think:

> "Insanity has been defined as doing the same thing over and over and expecting a different outcome. Negligence is described as doing the same thing over and over even though you know

it is dangerous, stupid, or wrong. Now that we know, it's time for a change. Negligence starts tomorrow." (W. B. McDonough 117)

As observed by Albert Einstein:

"If we are to solve the problems that plague us, our thinking must evolve beyond the level we were using when we created those problems in the first place." (W. B. McDonough 165)

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