

# Buildings as Living Systems within Living Systems

The Engineering Challenge: “*Design Components that Serve the Whole System*”

- Living Systems have energy to grow when internal and external energies are dynamically balanced; They fail when they become too rigid or too far out of balance with their ecosystems!
- Buildings like natural living systems must evolve internally and externally as the other systems in their universe change.
- The opportunity we face ( as engineers, entrepreneurs, politicians and citizens) is to *create* and *maintain* dynamically balanced facilities that optimize the available energy/resource mix to sustain our development and an abundant earth.



# Peak Oil as a Model for Building

*What is right and what is wrong with this model?*



<http://www.hubbertpeak.com/>

- It is a limited resource model  
-- And resources are limited!
- Would we design a building to fail if one resource runs out?
- What are the key resources that buildings need?
- How does this help us understand design problems?
- What does it tell us about *ourselves*?
- How can we improve the analytical model?

# Cradle to Cradle Systems Design

## *Emulating Nature's Material and Energy Flows*

Nature's ecosystems function on some key principles that human design can emulate.

- 1. There is no “waste” in nature; the waste from one organism provides nutrients for another.**
- 2. All life on earth is fueled by solar energy.**
- 3. Life thrives on diversity, constantly adapting to fill niches.**

Cradle to Cradle Design remodels human industry using these natural principles. It envisions a world powered by the sun where growth is good, waste is “nutritious,” and productive diversity enriches human and natural communities.

The application of cradle-to-cradle principles to industry creates cyclical material flows (cradle-to-cradle rather than cradle-to-grave) that, like the earth's nutrient cycles, don't recognize the concept of waste. Each material in a product is designed to be safe and effective, and to provide high quality resources for subsequent generations

*From McDonough.com “Cradle to Cradle Design Principles”*

# Dimensions of Capital and Innovation

*The Mystery of Capital*, Hernando De Soto

- *Property has multiple dimensions: resources, fungibility, collateral...*
- *When creative people have ownership they can innovate.*
- *When creative people are barred from ownership, they must become lawbreakers in order to innovate.*
- *in static property systems, squatters enable innovation*

*The Other Path (El Otro Sendero)*, Hernando De Soto

- *Fighting Terrorists Strengthens Them;*
- *Empowering Grass-Roots, Creative Producers Takes Power From Terrorists*

*Natural Capitalism*, Paul Hawken, Amory Lovins and L. Hunter Lovins

- *“Creating the Next Industrial Revolution” by reframing Capitalism*
- *Capitalize natural resources instead of depreciating them.*
- *Organize financial systems “as if living systems mattered”*

*The Battle for the Soul of Capitalism*, John Bogle (The Vanguard Group; mutual fund)

- *Subversion of Capitalism: diffusion of ownership away from innovators*
- *The vacuum of ownership power; managers manage for personal gain*
- *Ownership by financial institutions seek solely financial returns.*

# More Dimensions of Capital

## Intellectual Property as Capital

- *The patent system attempts to give ownership to innovators.*
- *But closed systems hinder innovation*
- *The Current Patent System needs help:*
- *Take out open source patents to prevent trolls from hindering innovation*
- *Mega-patents allow multiple inventors to pool related inventions*
- *Innovation Alliances empower inventors to collaborate and solve big problems*

## Efficiency as Capital

- *The more we save the more capital we have to work with*
- *How much energy do we waste fighting turf battles instead of innovating?*

## Global, Regional and Local Self Sufficiency as Capital

- *Rational Systems are dynamically adaptive systems within systems*
  - **Sports analogy. Leagues and Teams (although they often lose perspective)**
  - **Standards save work for everyone (but overly rigid standards hinder creativity)**
  - **Rationally compete about *things that matter* with appropriate rewards**
  - **Local self-sufficiency can strengthen the self-sufficiency of others**
  - **Expand economies with mutually beneficial collaboration and competition**

## Facility/building Adaptability and Efficiency as Capital

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# Waste:



*Forest to Desert* Lu Yongru (age 14) Hebei, PRC 2002

## **Waste is what we call resources we are not using productively.**

- If we use them, they are not waste! If we waste them, they stop support us.
- All processes (living and non-living) use resources and transform them into forms they cannot use;
- Yet all resources can be used by some process. Building Design must include the ecosystem in which they serve. Otherwise, they will fail in their purpose -- as above.

## **All resources are limited..**

- Until we learn how to reclaim them and put them back to work.
- Once we learn, we can have a sustainable supply of resources for the future.

## **Wasted resources contaminate our environment:**

- They make life less healthy, more expensive and less sustainable.

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# Climate Change: Wasted Resources Stop Growth

Climate Change includes Water and Soil Degradation  
as recognized by young Chinese children



Saharan Water: Zhu Siying Age 6, Hubei, PRC 2002

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Changes: Zeng Fei (age 15) Jiangxi, PRC 2002

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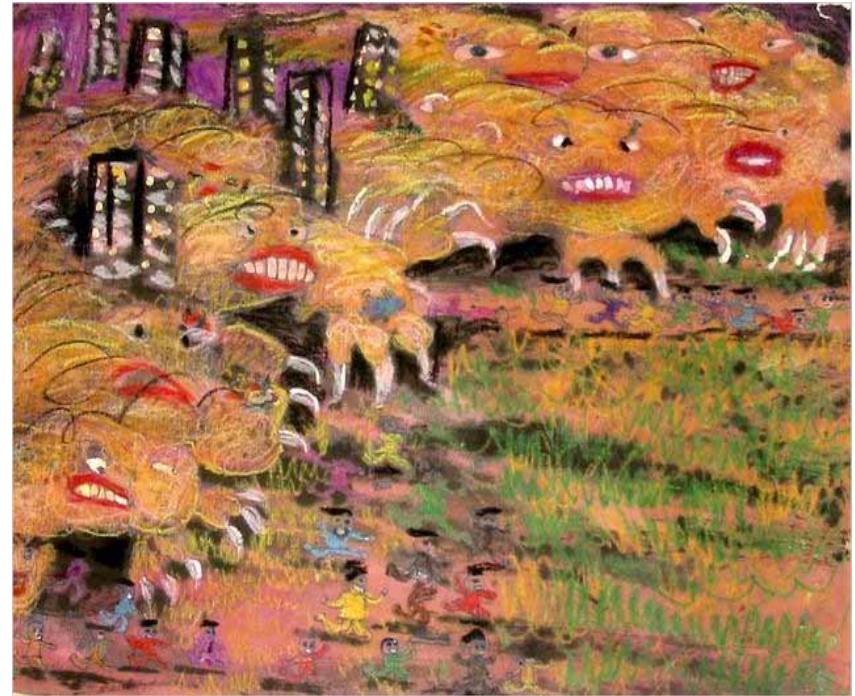
# More Wasted Resources Stopping Growth

Solar Dimming (polluted air) and Toxic Emissions  
as described by young Chinese children



***“It is popular to wear a Gauze mask”***

Li Xiaoxiang (age 10) Hubei, PRC 2002



***“The Sandstorm is Coming”***

Zhu Xi (age 9) Yunnan, PRC 2002



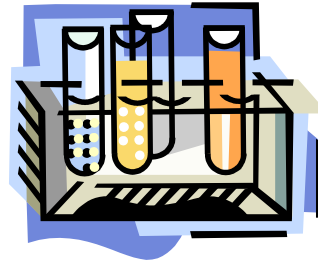
# Putting Carbon Back to Work



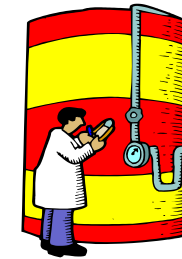
**Dry Ice and Liquid CO<sub>2</sub> for Food Processing/Handling**



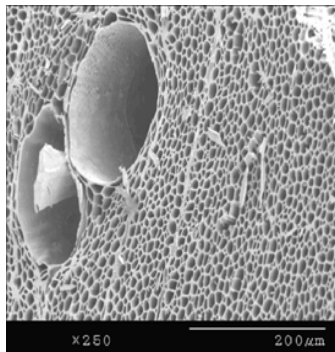
**Dry Ice for Ice Blasting**



**Clean Fuels, Fertilizers, Industrial Chemicals**



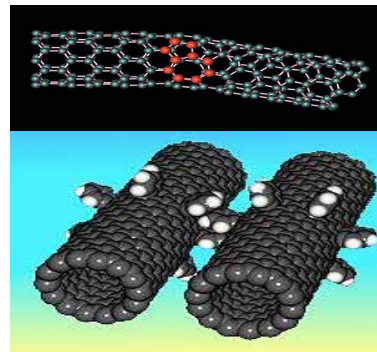
**Solvents gases and Firefighting Chemicals**



**Biochar (Terra Preta)**



**Corn Grown with Biochar as a soil amendment**



**Carbon Nanotubes Building Materials of the Future**



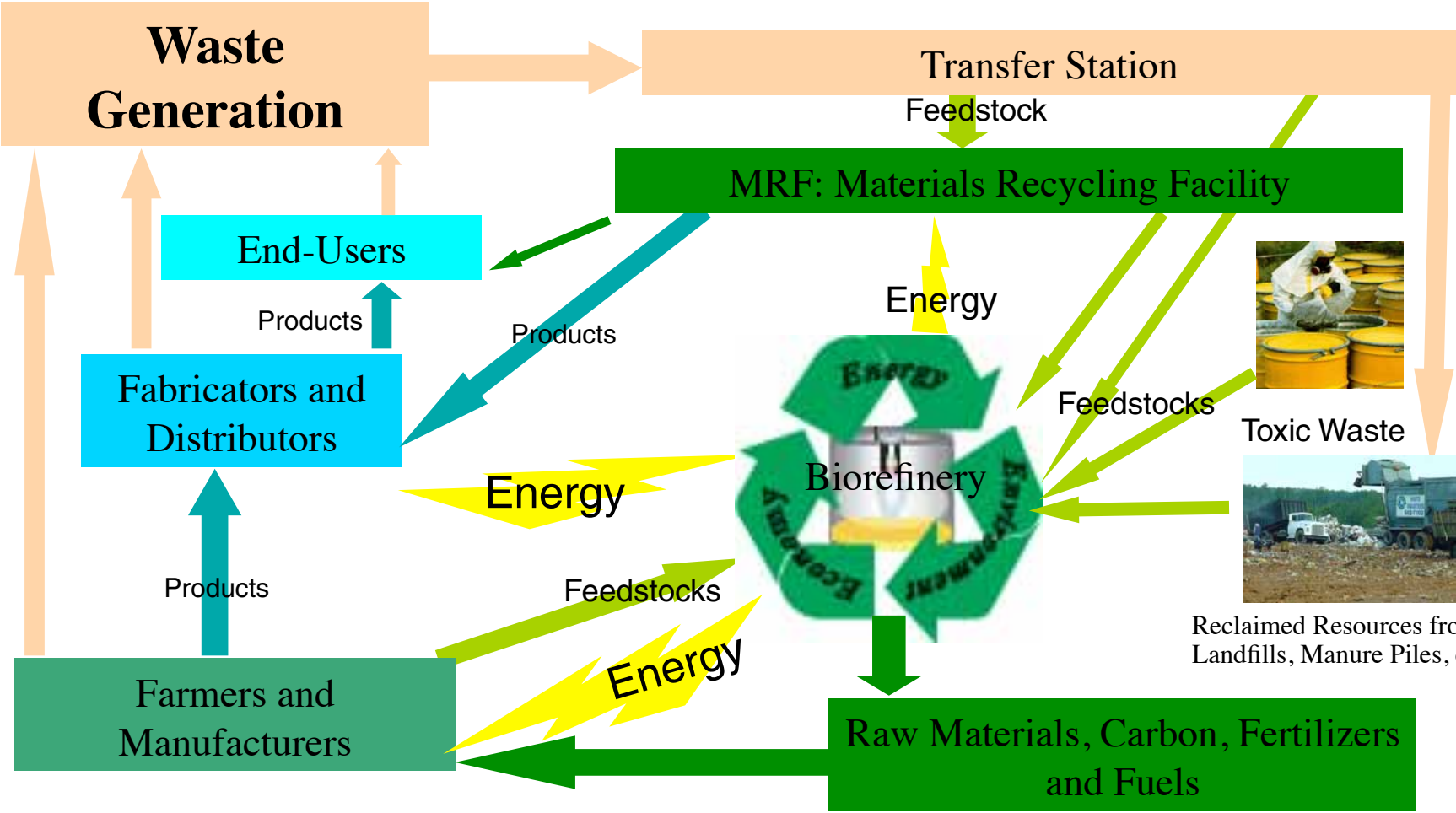
**Carbon Blacks Used for adhesives, sealants, building products, and more.**

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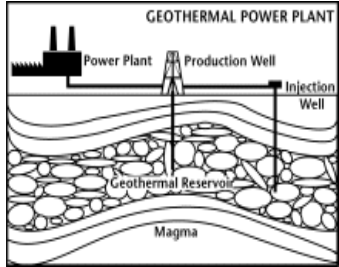
# Full-Cycle Resource Utilization System

More than one Building or Neighborhood



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From a System Perspective  
**Energy/Resource Sustainability is not about  
 Choosing the Most Efficient Source; It is about Optimizing the Mix!**



Geothermal



Landfills: Energy + Resources



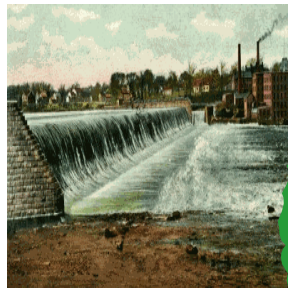
Solar



Wind



Efficiency



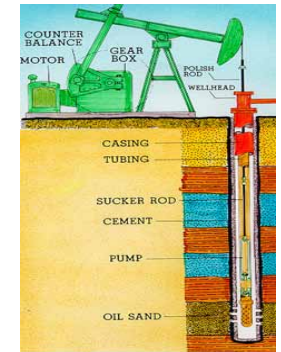
Hydroelectric



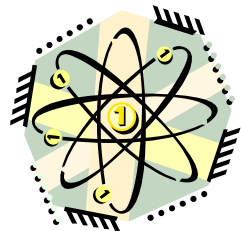
Innovative Alliances:  
 Global Innovation Networks



Biofuels



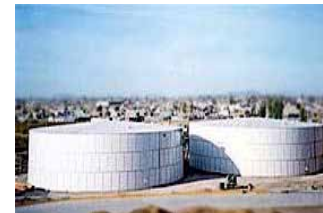
Oil and Gas



Atomic Power



Human Power



Anaerobic Digestion



Farmed Biomass

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# Innovative *Cybernetic* Systems

## Organizational Intelligence

### Energetic Ingredients

### Organizational Processes

**“Horse” Power -- Brain Power**

**Wind, Waves, Solar  
Energy Efficiency**

**Life Cycle Efficiency  
Healthy Air, Water, and Soil**

**Alternative Fuels  
Biomass Crops  
Biomass Waste**



**Creativity: IT and IP  
Innovation at all levels  
Global Innovation  
Networks**

**Animal + Man Power  
Cleaner Fossil Fuels  
Safe Nuclear Energy?**

**Lifelong Education  
Quality of Life - Economics  
Adaptive Alliance Building**

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# Buildings That are Sustainable and Teach Sustainability

## Sustainable Schools Guide

**The designer will employ energy and environmental features in a manner that is self-explanatory to the student, while still addressing typical design considerations and educational specifications.**

### Key Design Considerations

- **Site Design:** Courtyards, plants, pedways, trees, plants, signage
- **Daylighting & Windows:** students experience weather, light, solar energy, sundials and prisms to educate about sunlight.
- **Energy-Efficient Building Shell:** make purpose and function apparent, highlight glass and wall features. take photographs during construction to better explain the energy-efficient building systems
- **Renewable Energy Systems:** incorporate the full range of renewable energy options with explanations.
- **Lighting and Electrical Systems:** Use photovoltaic lights, LEDs, for pathway lights, staged and dimmable lights and meters to measure usage.
- **Mechanical and Ventilation Systems:** expose parts to show how they work.
- **Water Conservation:** incorporate rain water catchments and storage that is evident.
- **Recycling and Waste Mgmt:** recycling in every classroom and composting system for gardens.
- **Transportation:** Signage, Solar Recharging stations for buses, bike racks, pedways, etc.

# Wm. McDonough Architecture



- McDonough Braungart Design Chemistry (MBDC) has created *Cradle to Cradle™ Design*, a leading strategy for business to realize practical and profitable sustainable product development. This paradigm provides a unique vision, process and tools for optimizing quality and expanding industry leadership.
- The firm recently launched its *Cradle to Cradle™ Certification program*, which evaluates and certifies the quality of products based on Cradle to Cradle™ Design principles by measuring their positive effects upon the environment, human health and social equity.
- In the 1990s leading companies pursuing *Eco-Efficiency* realized cost savings. By pursuing our design paradigm, MBDC helps companies *not only reduce costs, but grow strategic opportunities*.

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# Experiment in Cross-Cultural Design

## Building Green Cities in China

**Can China move 400 million people to its cities without wreaking environmental havoc?**

*Eco-urban designer William McDonough says yes—and Beijing is listening.*

Sept. 26 - Oct. 3, 2005 issue - When American architect and industrial designer William McDonough visited the dusty Chinese village of Huangbaiyu, the villagers greeted him and his entourage of U.S. executives with a marching band, red carpet and fake red flowers to pin on their lapels.

**Huangbaiyu is set to become an experiment in ecologically balanced living, and McDonough is the visionary behind it.**

He and a team of Chinese and Americans have been charged with turning the village into a model of environmentally sound living. The team has begun construction on the first two demonstration homes and expect to build about 50 more by November to house some of the town's 400 families.

**If all goes as planned, families will move into a town center, increasing the amount of land available for farming, rather than live scattered about as they are now.**

*However, it did not go as planned.... “Best laid Plans....”*

# Trouble for China's Model Green City

**Much-ballyhooed plan of American architect William McDonough to build a model environmentally sustainable city in China has gone awry.**

May 10, 2007 - When American architect and industrial designer William McDonough visited the Chinese village of Huangbaiyu in the summer of 2005, he brought a great message of hope. As the co-chair of the China-U.S. Center for Sustainable Development, McDonough was the visionary behind an ambitious plan to transform the hamlet into a green village—a model of ecologically balanced living (see “Building in Green,” NEWSWEEK International, Sept. 26-Oct. 3, 2005). On that dusty summer day, **Chinese officials unveiled an ambitious project to build a new village, with hundreds of energy-efficient homes constructed with state-of-the-art material that would not harm the environment.**

**That was two years ago.** According to plan, by now the Huangbaiyu project should have been well on its way to becoming a world model for environmentally friendly living, not to mention the kind of international cooperation between the developed and developing world that many leaders say is essential to combat big environmental problems. **WHAT WENT WRONG? ANY IDEAS?**

**Instead, it has become a cautionary tale in what can go wrong with grand plans to save the world from environmental catastrophe.** The project appears to be a mess. Construction of the 400 houses is way behind schedule. The 42 that have been built still have no heat, electricity or running water. Walls are already cracking and moisture seeps through the ceilings. According to people who’ve worked on the project, many of the houses don’t adhere to the original specifications—meaning they could never achieve the energy savings they were meant to achieve. The biomass gasification facility meant to burn animal, human and agricultural waste, doesn’t work. **Not surprisingly, no one in the village has volunteered to move into the new community.**



# Governments and Businesses cannot do it without help!

Sustainability requires everyone involved to change their thinking and behavior to:

1. Empower *full-cycle* energy/resource regenerative processes
2. Monetize *multiple bottom line values* (*more than: people, planet, profit*)
3. Put *supply and demand* to work for all of them!



Forest: Li Jiajin (age 12) Guizhou



Plant Trees. Ma Yan (age 11 ) Xinjiang

“Act Locally, Think Adaptively” The Context is Changing Ecosystems”

- **Innovation/Creativity**
- **Economic Health**
- **Mental Health**
- **Social Health**
- **Environmental Health**
- **Environmental Justice**
- **Political Development**



The Garden City, Zhu Wei (age 13) Shanghai



Welcome to the Green Dragon City  
Zhang Jun (age 11) Guangxi



# E3 Regeneration Solutions, Inc.

*Regenerating Energy, Environment, Economy*

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