



*Life-Cycle Assessment: National
and Regional Policies*



- Embodied Energy of a Building will Continue to Gain in Importance in the Total Carbon Footprint of a Building.
 - Transportation energy can be a major component of material decisions
- Policy Implications of the Reduction of GHG from the Operations and Materials of a Building

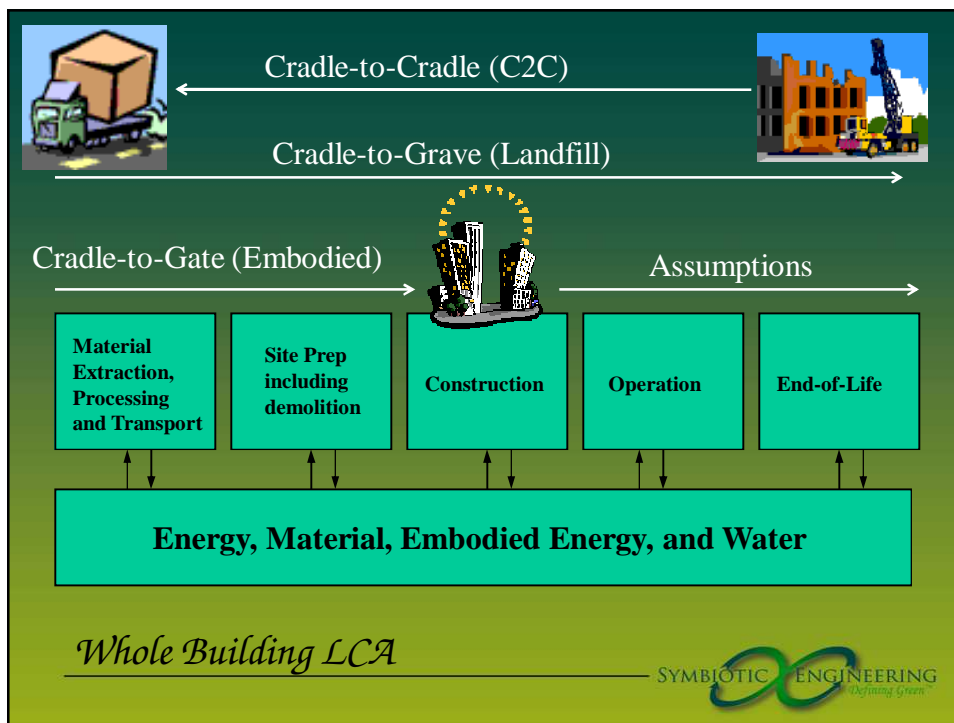
Major Points



- “The inclusion of Life Cycle Analysis (LCA) is an important step in the technical development of LEED.”
- “Reduced material consumption lowers the overall embodied energy of the building, which has a direct impact on the building’s carbon footprint.”

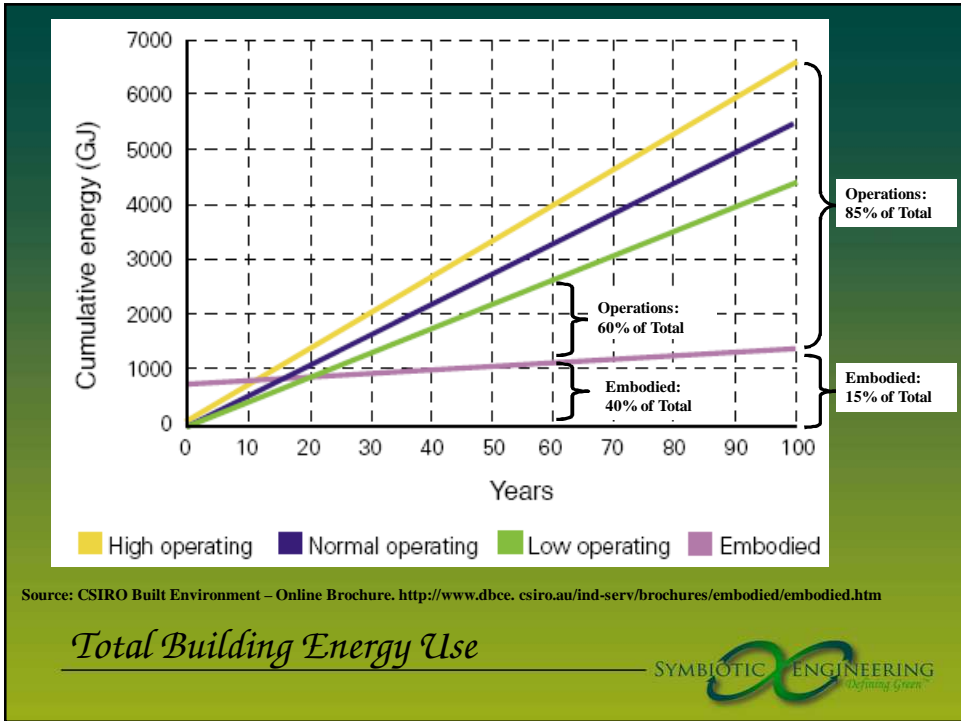
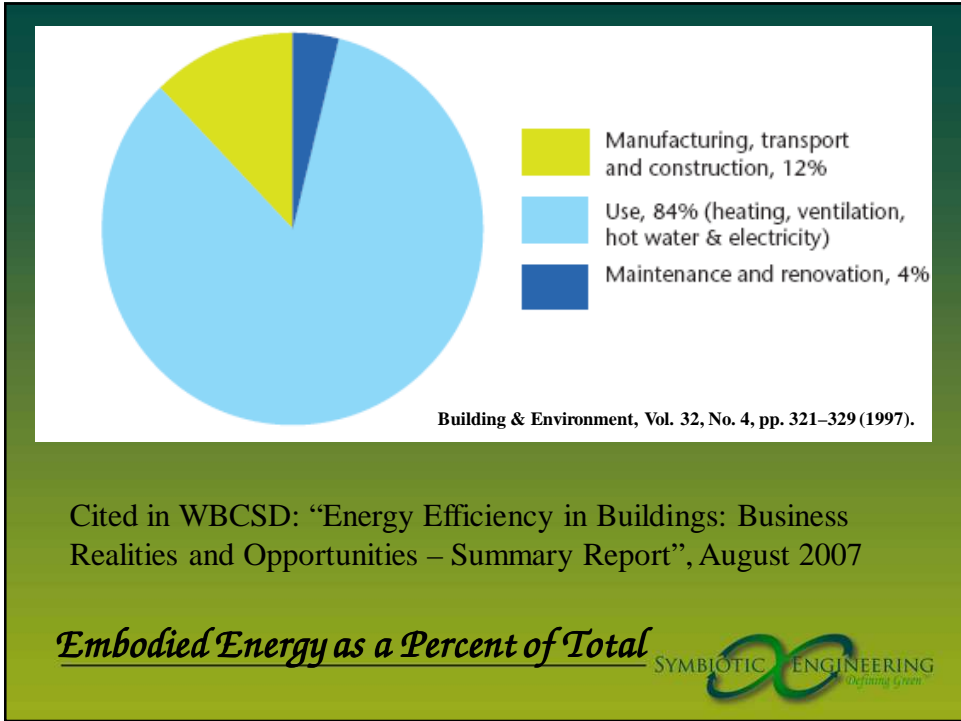
Statement of USGBC Educational Committee before the Senate Committee on Environment and Public Works – May 15, 2007.

Embodied Energy and LEED



Whole Building LCA





- Temporal –
 - Longer service life reduces the overall contribution of embodied energy
- Building Efficiency –
 - Higher efficiency buildings increase the contribution of embodied energy
- Climate Zone –
 - A more temperate climate will raise the contribution of embodied energy to the total

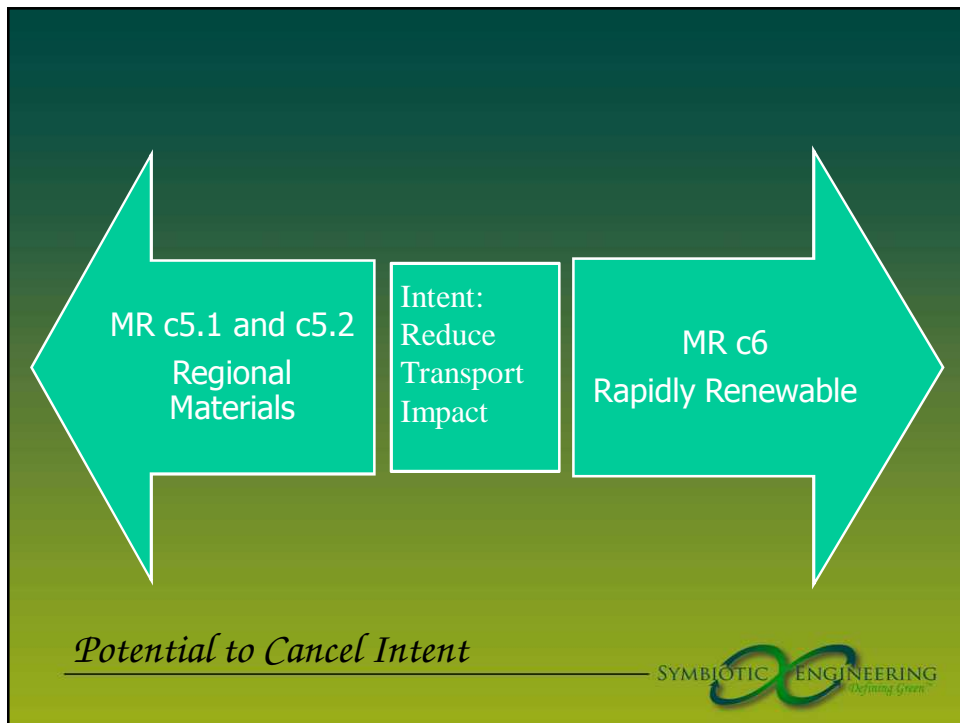
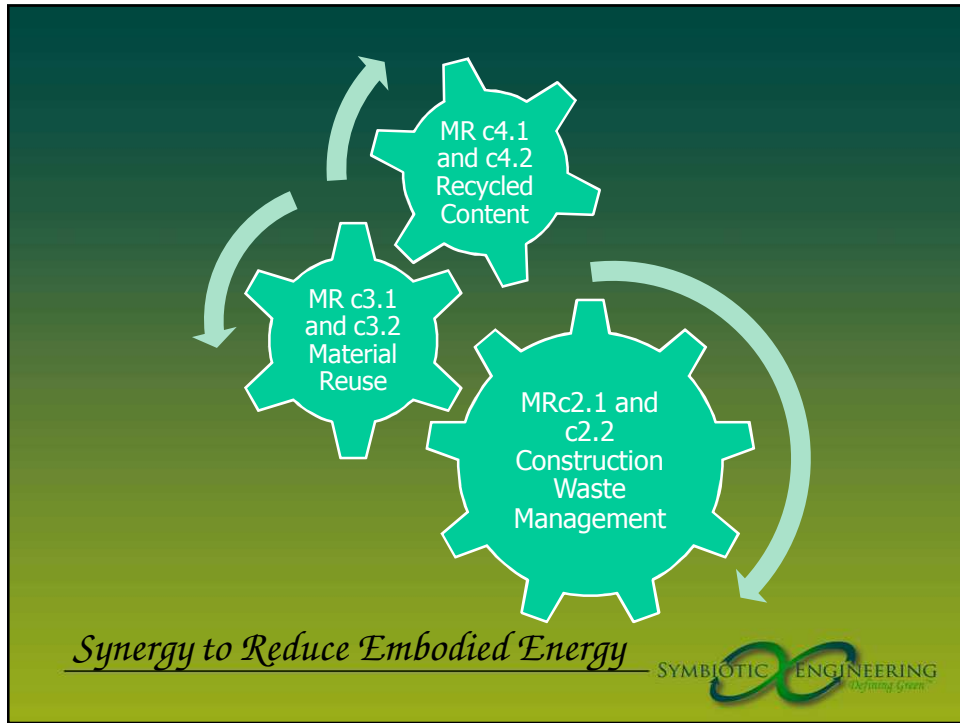
Embodied Energy's Relation to Total



- How do LEED credits work to reducing the embodied energy of a green building?

LEED and Embodied Energy





- Question: Which material has a higher embodied energy?
 - 1 ton of Bamboo Flooring from the “Bamboo Sea” in the Hunan Province delivered to Denver, Colorado
 - 1 ton of concrete from local sources delivered to a project in Denver, Colorado

Embodied Energy Trivia



Table 1: Emissions and Embodied Energy of Transport per Ton-Mile Freight

	Energy Use MJ/ton-mile	GWP lb CO ₂ e/ton-mi	Reference
Ocean Freighter	0.28	0.05	NREL US LCI Database, 2007
Locomotive	0.37	0.06	NREL US LCI Database, 2007
Barge	0.54	0.09	NREL US LCI Database, 2007
Cargo Plane*	1.15	0.17	NREL US LCI Database, 2007
Combination Truck	1.54	0.26	NREL US LCI Database, 2007
Single Unit Truck	3.29	0.56	NREL US LCI Database, 2007

* = Cargo Plane database only includes CO₂-related GHG emissions. Additional GHG releases, such as N₂O and CH₄, would likely increase GWP (lb CO₂e/ton-mi) by an additional 1%.

- Ocean freighter 32% more efficient than rail
- Rail 4x more efficient than combination truck and 9x more than single unit truck.



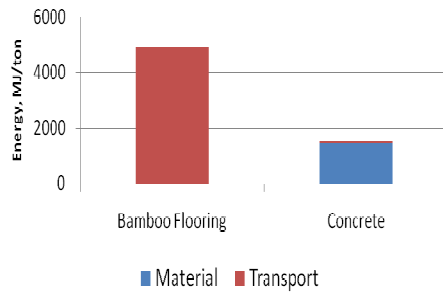
Table 2: Energy and Emissions Associated with Manufacture and Transport of One-ton of Bamboo Flooring and One-ton of Concrete

Material			Transportation				Cumulative Impact	
Item	Energy, MJ/ton	Emissions, lb CO ₂ e	Mode	Distance, mi.	Energy, MJ	Emissions, lbs CO ₂ e	Energy, MJ	Emissions, lbs CO ₂ e
Bamboo Flooring	15	4.5	Truck	500	1645.0	280.0	4943.1	809.4
			Ship	7,362	2061.4	368.1		
			Rail	1,221	451.8	73.3		
Concrete ¹⁰	1452.3	446.7	Rail	177	32	12.0	1537.3	475.4
			Truck	58	53	16.3		

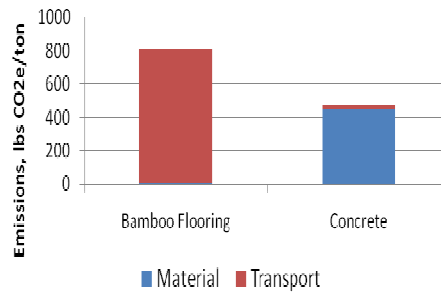
Material and Transportation Energy



Embodied Energy (per ton of material delivered)



Emissions, CO₂e (per ton of material delivered)



Which Material is Low-Energy?



The Impacts of Green Buildings on the Environment



Are Green Buildings Improving the
Environment?

What Environmental Claims Can Green
Buildings Make?

How Can the USGBC Increase the Verifiable
Environmental Benefits of Green Buildings?



- Building Sector and GHG Emissions
 - 48% of all U.S. GHG emissions
 - 76% of U.S. power plant output
- **Goal: Carbon-neutral buildings by 2030**
- What does a carbon-neutral building really mean?

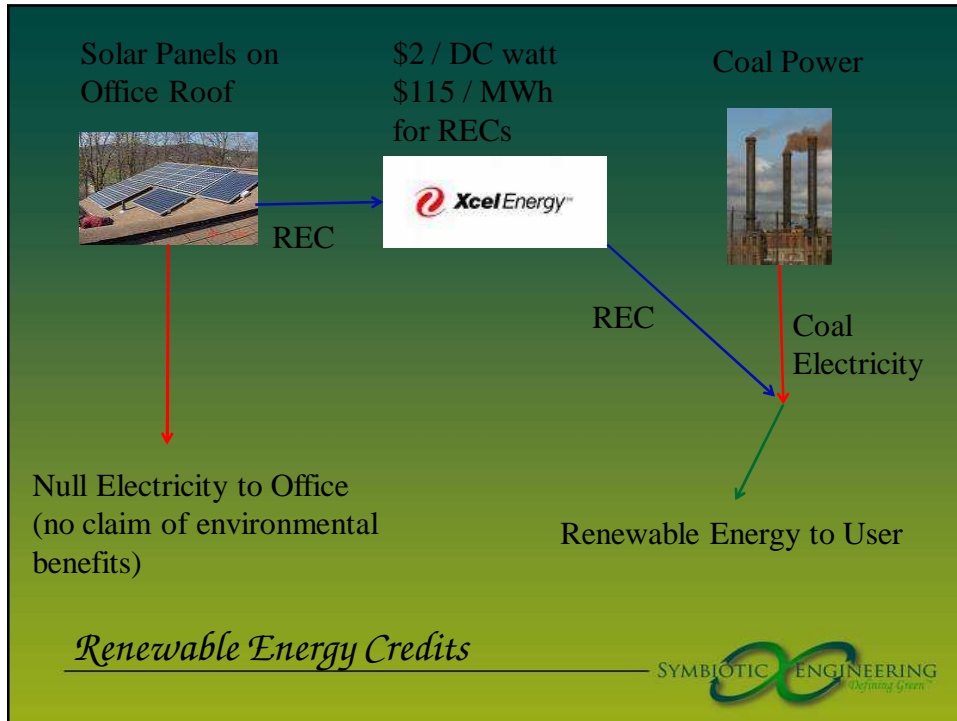
Building Sector Impacts



- Building uses no greenhouse gas emitting energy
- Up to 20% can be covered through purchase of carbon offsets or renewable energy credits (RECs)
- Embodied energy is not included in the definition of a carbon-neutral building

Carbon-neutral Buildings





- Carbon Offsets
 - Pay for GHG reductions made through outside projects
 - Renewable energy, energy efficiency, tree planting
 - Domestic or international
 - Wide variation in quality – Buyer Beware
 - CDM Gold Standard, Voluntary Carbon Standard
 - Additional, verifiable, permanent

Carbon Offsets

- How can a well-intentioned environmental policy fail to make a significant environmental impact?
- A Colorado Example
 - Renewable portfolio standard
 - 20% by 2020 – reduces GHG emissions/kWh
 - However, Comanche 3 coal plant in Pueblo cancels RE emission benefits
- How does this example serve as a precautionary tale for the USGBC?

Environmental Policies



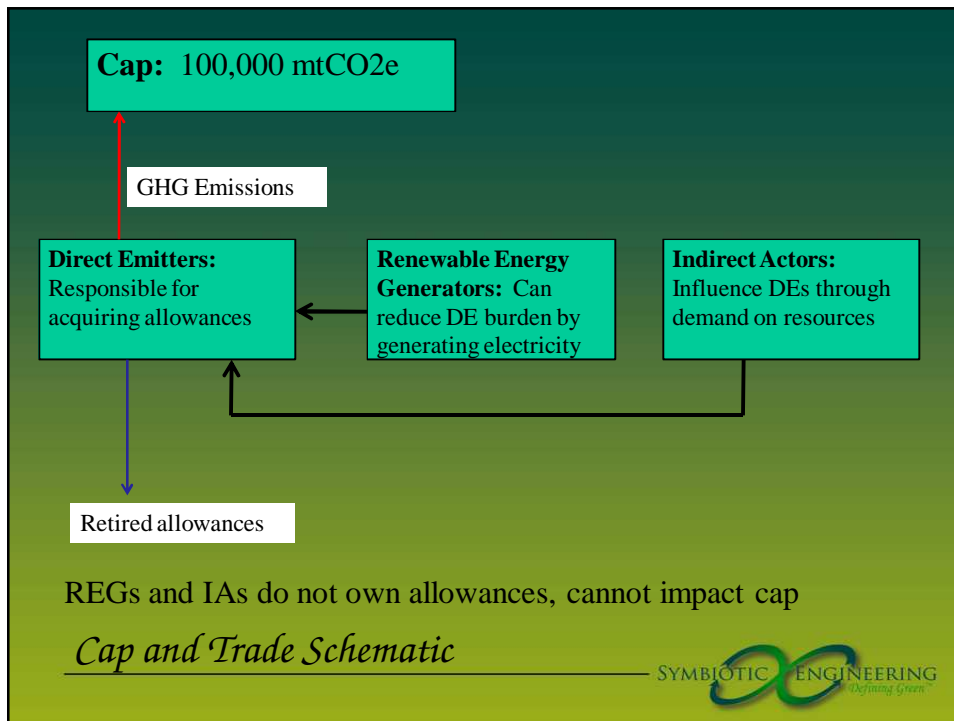
- Carbon Cap and Trade
 - Sets a maximum level for GHG emissions
 - Allowances given freely or auctioned, traded in markets
 - Cap lowered over time
- Major players
 - Direct Emitters (DEs)
 - Electric utilities, cement plants
 - Renewable Energy Generators (REGs)
 - Distributed solar, wind
 - Indirect Actors (IAs)
 - Buildings, consumers, USGBC

Carbon Cap and Trade



Do reductions in building energy use lower GHG emissions under a carbon cap and trade system?

Cap and Trade & USGBC



Renewable Energy Generator



Energy Efficient Green Building



What's the Difference?



What policy options are available to ensure that energy efficient green buildings verifiably reduce GHG emissions under a cap and trade system?

Demand Side Policy Options



- Set-Aside
 - Certain percentage of allowances specified for “eligible activities” (renewable energy and energy efficiency)
 - Retiring allowances provides clear claim of environmental benefits
- Should there be set-asides for the lowest carbon footprint buildings?

Set-Aside

SYMBIOTIC ENGINEERING
Defining Green

- Output-based Allocation
 - Allowances granted to generators based on the quantity of energy produced
- Should energy efficient buildings be given allowances based on reduced electricity demand?

Output-based

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- Cap reduction
 - Demand for renewable energy is considered when setting or reducing the cap
- Could the USGBC lobby for a lower cap based on building energy use reduction initiatives like the 2030 Challenge's carbon neutral building goal?

Cap Reduction

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How can the USGBC best ensure that its positive environmental initiatives translate into real, verifiable environmental benefits?

Consider:

- Embodied Energy
- Ownership of Renewable Energy Credits
- Influence as Demand Side Actors

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Defining Green

Thank You

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Presentation Available on
www.symbiotic-engineering.com

Thank You

