



# Engineering for Life: A Case Study in the Use of Design for Environment to Create a Sustainable Product

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October 14, 2009

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## This session will:

- ⇒ Provide an overview of “Material” credits in Environmental Building Rating Systems
  - Leadership in Energy and Environmental Design™ (LEED)
  - Green Guide for Healthcare
- ⇒ Suggest an alternative approach product design
- ⇒ Provide a Case Study regarding how multiple environmental impacts should be considered during material or product design.

# LEED Overview

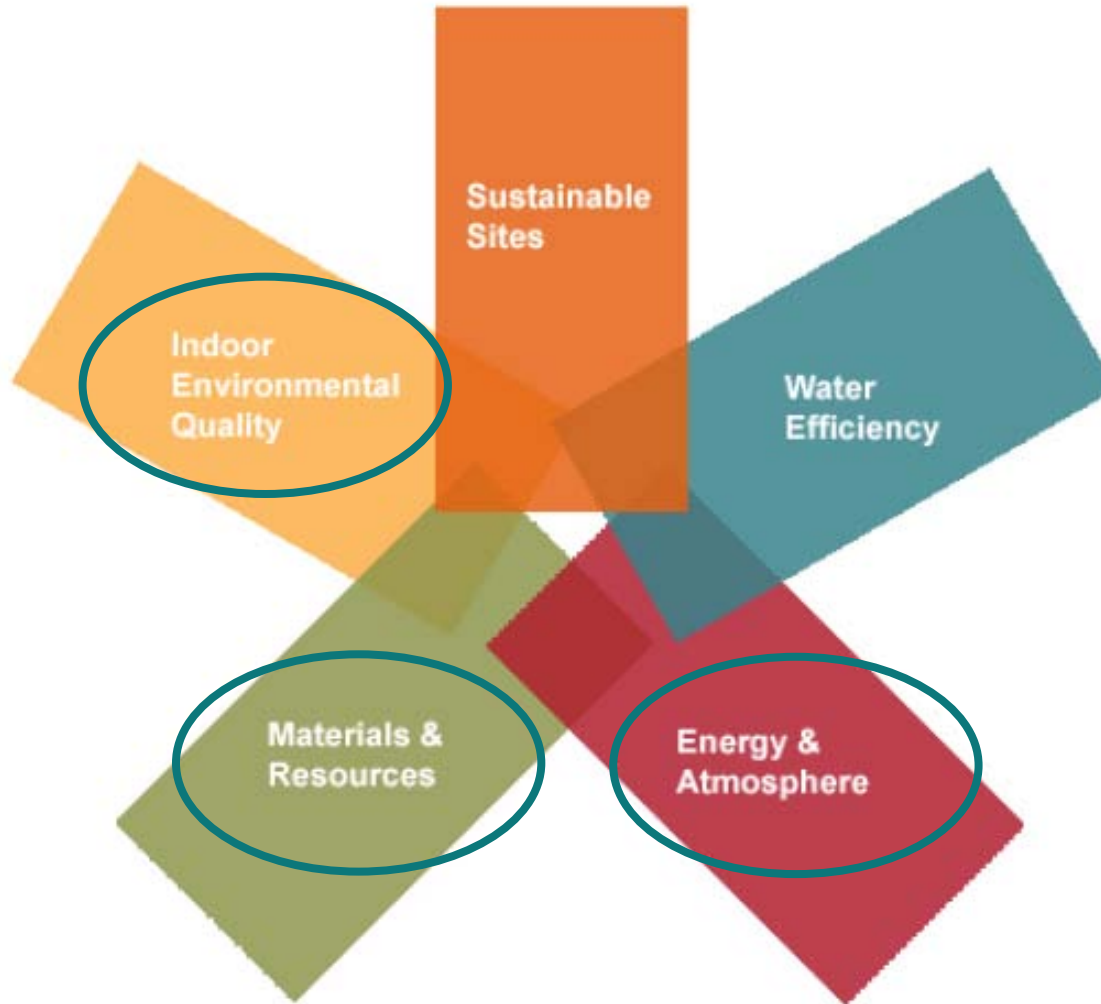


## Leadership in Energy and Environmental Design™

- ⇒ United States Green Building Council (USGBC)
- ⇒ Rating System for buildings and interiors
- ⇒ 385 million SF certified
- ⇒ ~25,000 registered buildings
- ⇒ Four levels of certification:
  - Certified - 40+ points
  - Silver – 50+ points
  - Gold – 60+ points
  - Platinum – 80+ points



# LEED Focus (Categories)



Approximately 40% of overall points are related to materials

# LEED Materials & Resources



Credit Number	Title	Points
MR Credit 1	Building Reuse	4
<b>MR Credit 2</b>	<b>Construction Waste Management</b>	<b>2</b>
MR Credit 3	Materials Reuse	2
<b>MR Credit 4</b>	<b>Recycled Content</b>	<b>2</b>
<b>MR Credit 5</b>	<b>Regional Materials</b>	<b>2</b>
<b>MR Credit 6</b>	<b>Rapidly Renewable Materials</b>	<b>1</b>
<b>MR Credit 7</b>	<b>Certified Wood</b>	<b>1</b>
Total Points:		14

5 credits provide opportunities to select sustainable materials

# LEED Materials & Resources

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## ⇒ Construction Waste Management

- Divert construction debris from landfill – this must be used in something else!
- 50 or 75% by weight or volume

## ⇒ Recycled Content

- Use materials with recycled content
- Post-consumer + ½ Pre-consumer
- Based on total cost of the materials (10% or 20%)

## ⇒ Regional Materials

- Use materials extracted, harvested or recovered, and manufactured, within 500 miles of the project site
- Based on the total cost of materials (10% or 20%)

## ⇒ Rapidly Renewable Materials

- 2.5% of the total cost of all building materials or products

# LEED Energy & Atmosphere



Credit Number	Title	Points
Credit 1	Optimize Energy Performance	19
Credit 2	On-Site Renewable Energy	7
Credit 3	Enhanced Commissioning	2
Credit 4	Enhanced Refrigerant Management	2
Credit 5	Measurement and Verification	3
Credit 6	Green Power	2
Total Points:		35

## ⇒ Optimize Energy Performance

- Demonstrate specific decreases in energy as compared to ASHRAE Standard 90.1-2007 baseline – less energy used means more points

## ⇒ On-Site Renewable Energy

- Use on-site renewable energy systems to offset building energy costs

# Indoor Environmental Quality



Credit Number	Title	Points
Credit 1	Outdoor Air Delivery Monitoring	1
Credit 2	Increased Ventilation	1
Credit 3	Construction Indoor Air Quality Management Plan	2
<b>Credit 4</b>	<b>Low-Emitting Materials</b>	<b>4</b>
Credit 5	Indoor Chemical & Pollutant Source Control	1
Credit 6	Controllable Systems	2
Credit 7	Thermal Comfort	2
<b>Credit 8</b>	<b>Daylight &amp; Views</b>	<b>2</b>
Total Points:		15

2 credits provide opportunities to select sustainable materials



# Indoor Environmental Quality



## ⇒ Low Emitting Materials

- Adhesives and Sealants
- Paints and Coatings
- Flooring Systems
- Composite Wood and Agrifiber Products
  - No added urea-formaldehyde resins

VOC  
Limits  
Provided

## ⇒ Daylight & Views

- Specifies minimum day lighting values in spaces
- This requires new / more glass applications and reflective surfaces

All materials related credits in LEED are single attribute credits

# Green Guide for Healthcare



- ⇒ Self Certifying Healthcare Facility Assessment System
- ⇒ Similar to LEED for Healthcare
- ⇒ GGHC encourages change within the health care industry
- ⇒ Reduce the release of persistent bioaccumulative toxic chemicals (PBTs)



Credit Number	Title	Points
Credit 4.1	PBT Elimination: Dioxins	1
Credit 4.2	PBT Elimination: Mercury	1
Credit 4.3	PBT Elimination: Lead & Cadmium	1

All materials related credits are single attribute credits



## ⇒ All material credits are single attribute

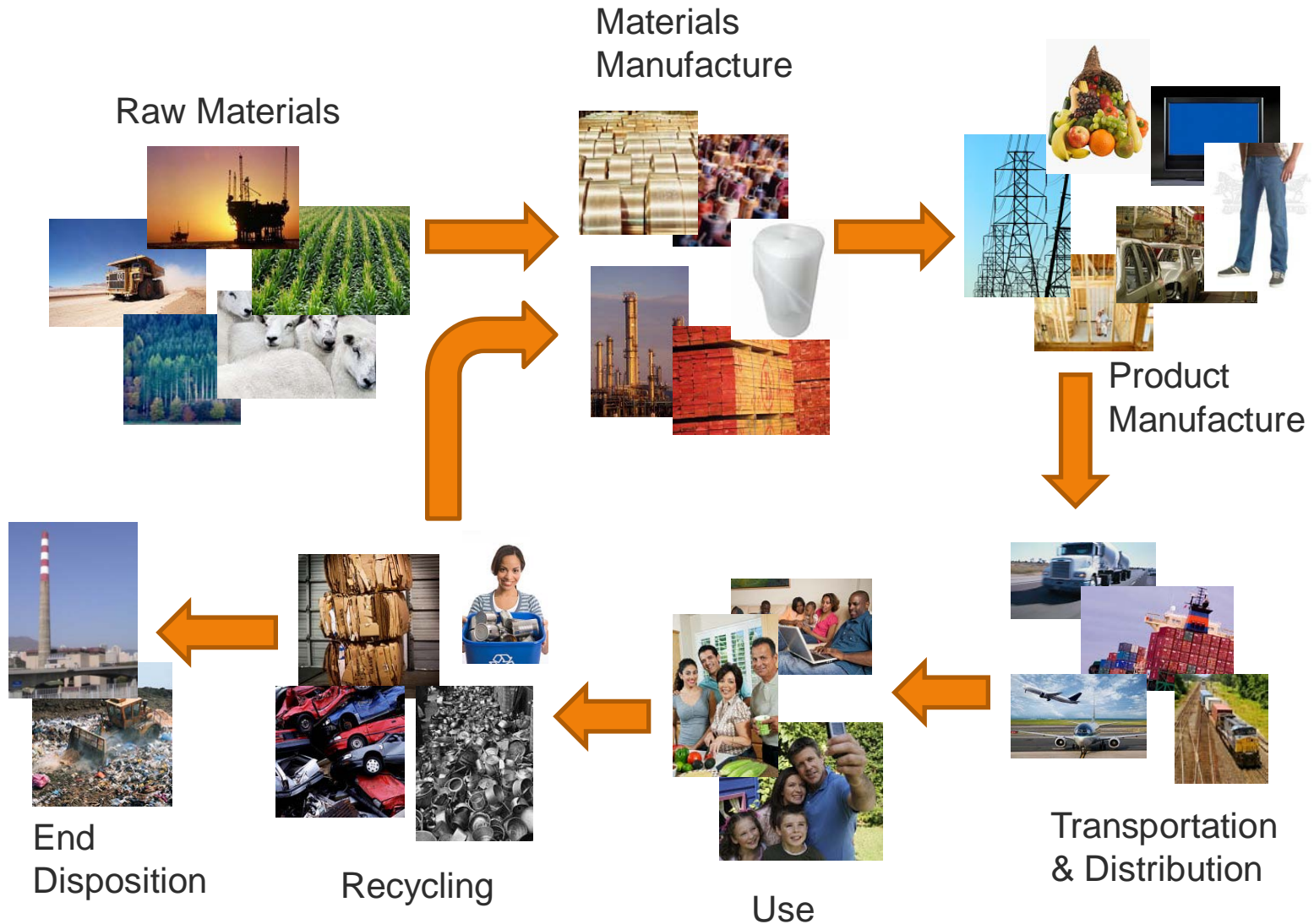
- Address one-issue
- Snap shot in time
- May conflict with another issue
- Example: Recycled Material may require more energy to process than virgin material

## ⇒ Is there another approach?



# What is Life Cycle Thinking?

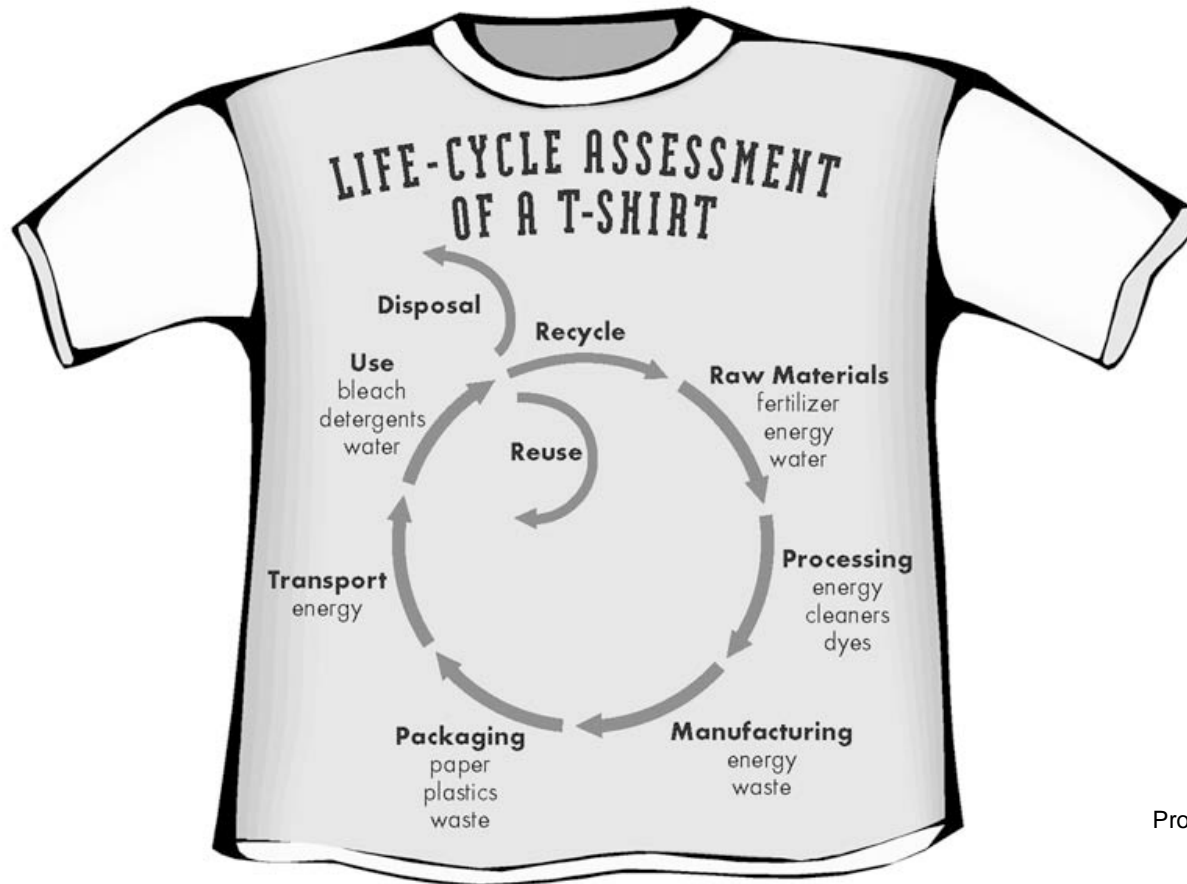
# Life Cycle Assessment



# Life Cycle Assessment



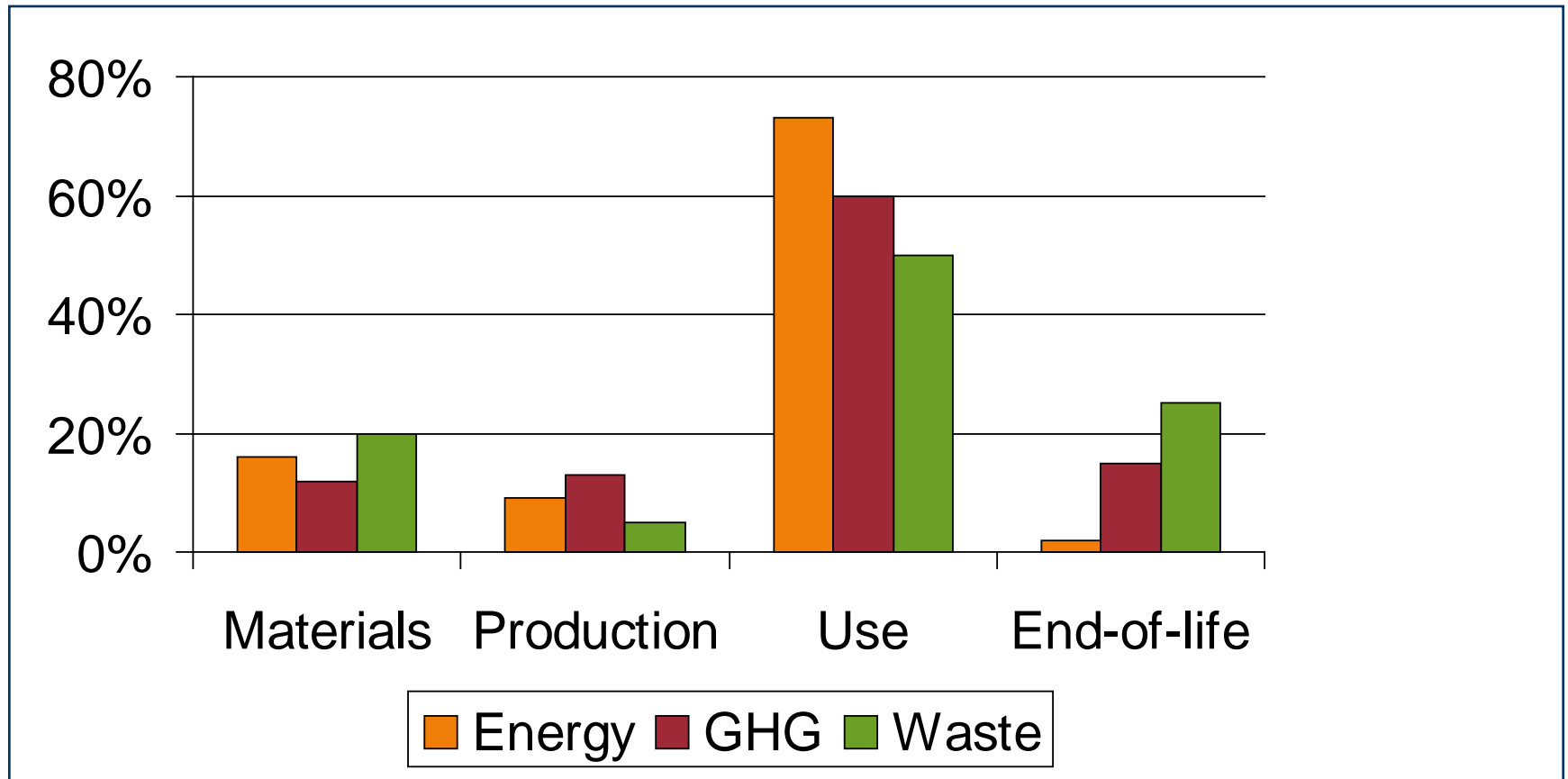
⇒ LCA is a tool to systematically measure **all** the environmental impacts associated with each stage of a product's life-cycle



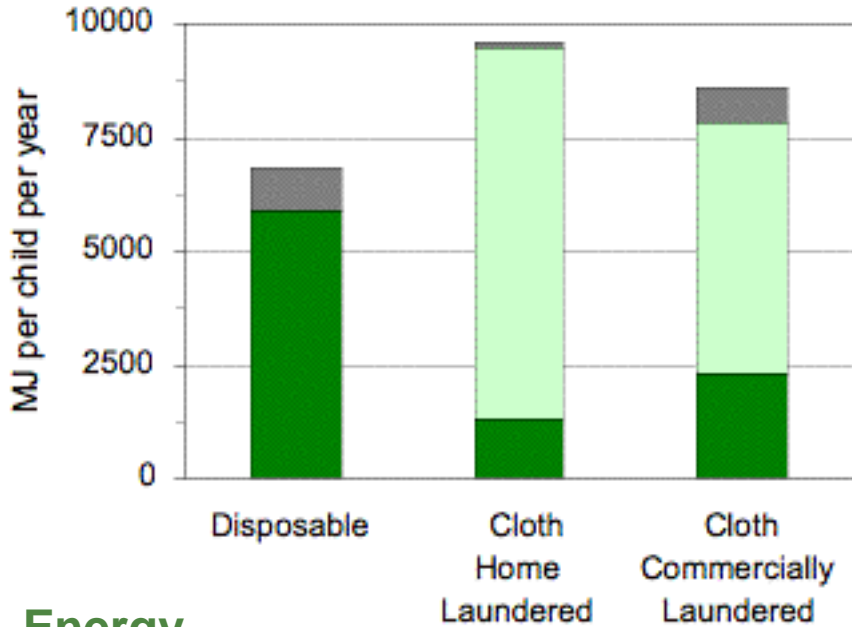
# Life Cycle Assessment



*Assessment of relative impacts across life-cycle – 3 issues are included*



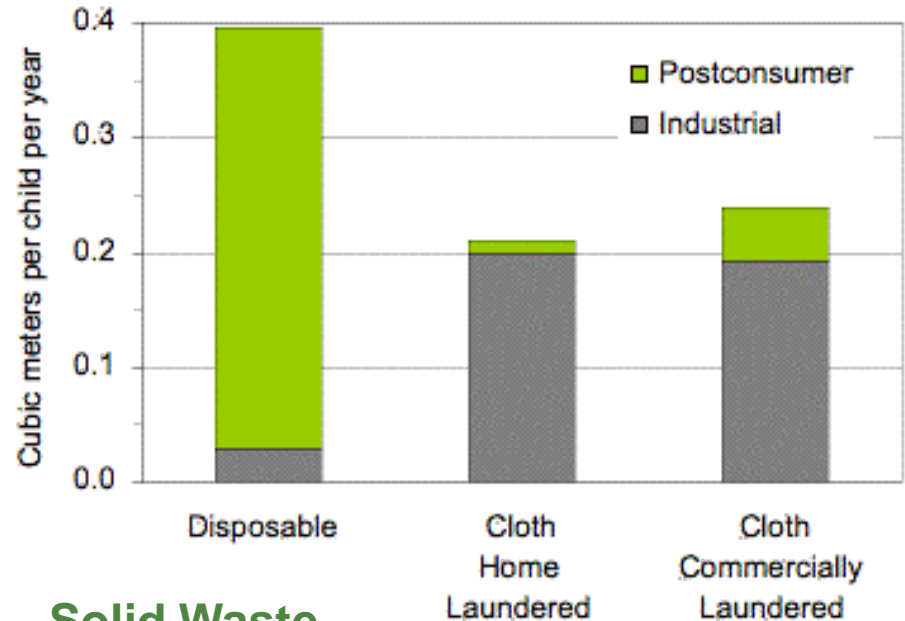
# Life Cycle Assessment – The Diaper Debate



- Misc Energy
- Washing Energy
- Feedstock and Process Energy



## Energy



## Solid Waste



# Life Cycle Assessment

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## Limitations:

- ⇒ Results - only as good as the data available
- ⇒ Data intensive
  - Not to be underestimated
  - Inventory data often difficult, sometimes impossible to acquire
- ⇒ Effects of new technologies are not always able to be understood / defined in terms of impact
  - Biodiversity, genetically modified organisms, resource allocation, nanotechnology
- ⇒ Objective Tool – *Does not necessarily reflect what the marketplace considers important*

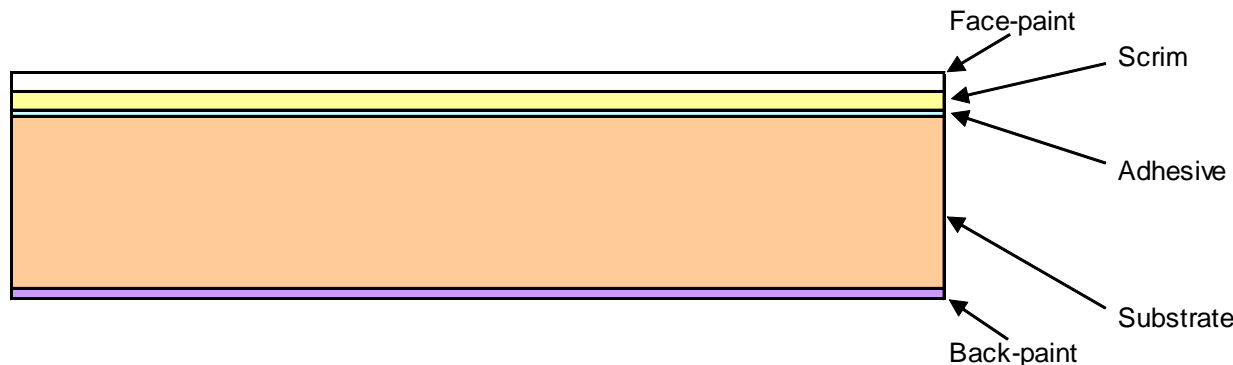
LCA will be included in the next generation of sustainable building standards

# Case Study – Tierra® Ceiling Tile

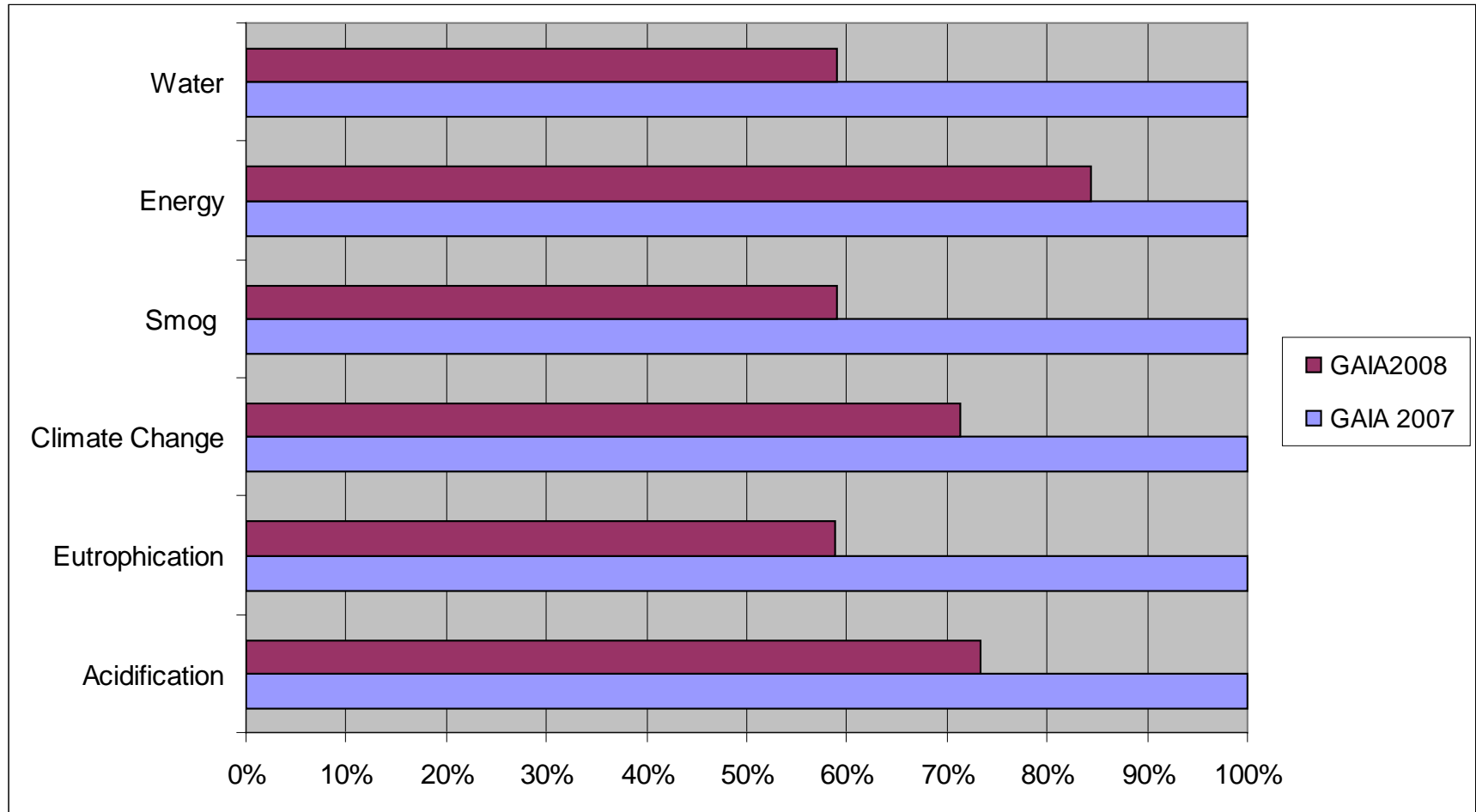


## Engineered to be “Sustainable”

- ⇒ Focused on many impacts, not just one attribute
- ⇒ Iterative life cycle assessments (LCA)
- ⇒ Reduced environmental impacts based on LCA results
  - Removed back scrim
  - Modified scrim adhesive formulation
  - Updated substrate to include reclaimed jute
  - Modified jute LCI file to include energy & transport
  - Modified scrim material
  - Modified coating formulation



# Tierra & LCA Evolution



# Case Study – Lessons Learned

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- ⇒ LCA is key to understanding and reducing environmental impacts
- ⇒ Verify data sources
- ⇒ It is not a once and done process – requires multiple analyses.
- ⇒ Not intuitive – results are not always what is expected
- ⇒ Can design a product that reduces environmental impacts

# Summary

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- ⇒ Sustainable materials play an important role in building rating systems
- ⇒ Codes and standards are being developed worldwide which will encourage the use of sustainable materials
- ⇒ Single attributes will be replaced with multi-attribute (LCA) assessments
- ⇒ Materials Scientists must be involved



Questions?

