



# Sustainability Performance Metrics, an integral part of the decision making process

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# Goals

- What is the most powerful quantified framework for quantifying environmental sustainability?
- To learn about life cycle assessment
- To see LCA-software
- To know how to find your way around
- To define what role LCA can play for you
- To get quizzed to the point of a headache



## With LCA you can

- Quantify environmental performance
- Compare alternative designs
- Direct ecodesign and innovation
- Perform multi-criteria assessments
- Built upon existing BOM and cost statement models



# Life Cycle Thinking =

- No trade-offs in life cycles
  - It is not only design and construct, it is operations too
  - Where does it come from and where does it end up
- No trade-offs in different aspects of Sustainability
  - One-issue thinking forgets other issues



## 10 out of 10

- **What best describes the environmental footprint of each daily activity?**
- Source: *Stuff the Secret Lives of Everyday Things*, by Ryan and Durning, copyright 199, Northwest Environment Watch, Seattle;
- Used with permission by Fivewinds / Interface / Armstrong / Rio Tinto Minerals at the USGBC GreenBuild Conference 2006.



## 10 out of 10

### 1. Coffee - 2 cups per day

- a) Drinking 2 cups of coffee per day requires 12 trees and 11 pounds of fertilizer annually
- b) Coffee farming destroys fragile tropical ecosystems
- c) Requirement for me to stay awake at work
- d) Answers: a & b

### 2. Newspaper

- a) 85% of newspaper is recycled after use
- b) Approx. 4 billion pounds is sent to US landfills each year
- c) Approx. 4 billion pounds is sent to worldwide landfills
- d) Newspaper is black & white and read all over



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# Life cycle assessment (LCA)

We use world-leading software and databases and apply ISO standards

- ISO 14041 Goal and Scope Definition
- ISO 14042 Inventory Analysis
- ISO 14043 Interpretation
- ISO 14044 Guidelines and principles
- ISO 14025 Type III environmental declarations

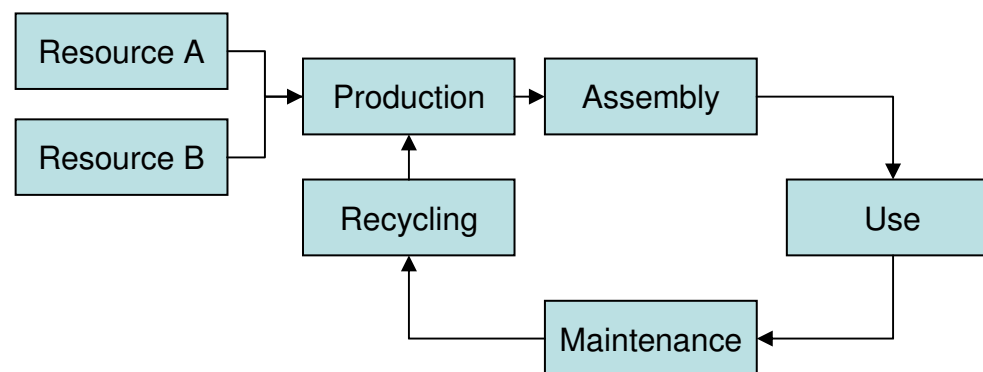




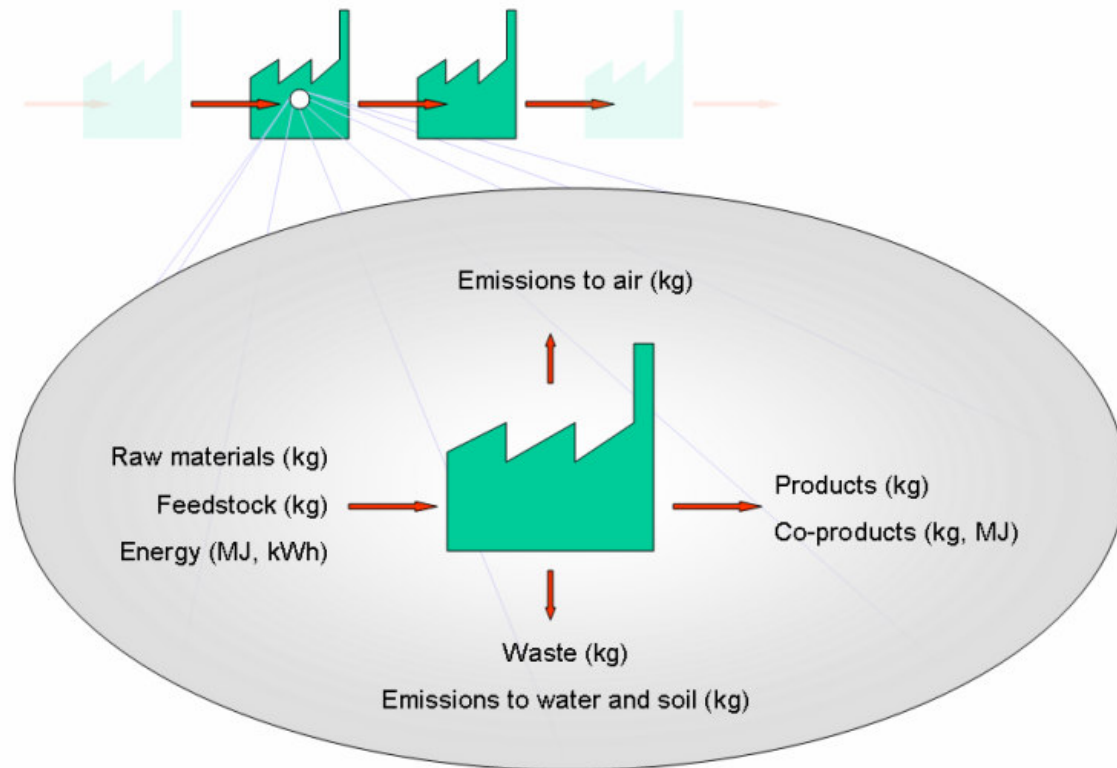
# Life cycle assessment (LCA)

LCA is a powerful tool for assessing the environmental performance of products, services or scenarios

It is based on material and energy flows for processes and materials that together form a life cycle



# Life Cycle Assessment (LCA)





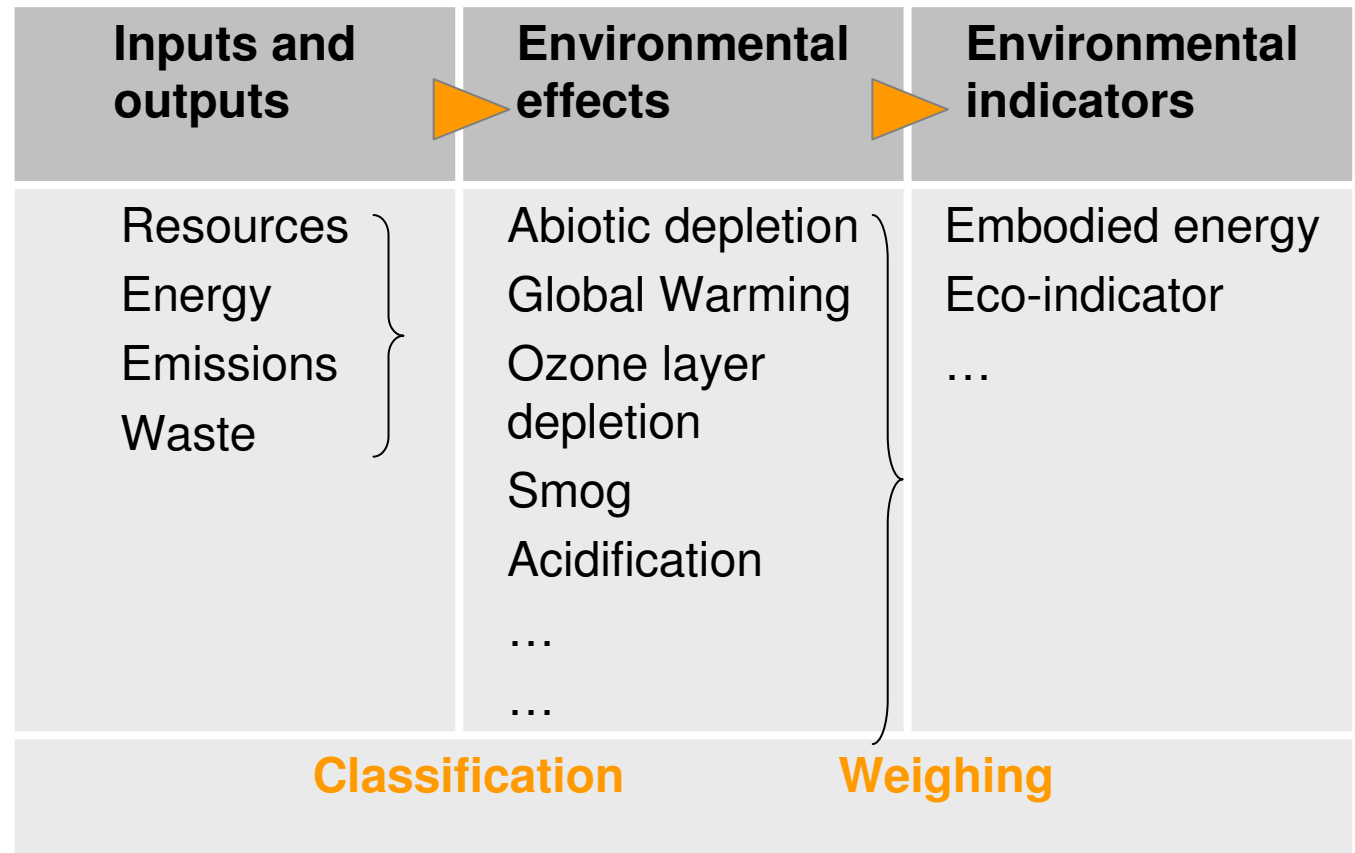
# Impact Assessment

## A range of impact categories

- global warming
- depletion of non-renewables
- depletion of the ozone layer
- acidification
- eutrophication
- summersmog
- aquatic ecotoxicity
- terrestrial ecotoxicity
- human toxicity
- energy
- non-hazardous waste
- hazardous waste
- ...



# Impact Assessment





# Impact Assessment

Inputs and outputs	Environmental effects	Environmental indicators
1 kWh of electricity	Global Warming	

## Use of equivalency factors

*From carbon dioxide and methane to global warming*

1 kg carbon dioxide = 1 kg GWP-equivalents

1 kg methane = 24 kg GWP-equivalents

-----  
Total = 25 kg GWP-equivalents

Source: IPCC



## 10 out of 10

### 3. Polyester in your T-shirt

- a) 10 times its weight in CO<sub>2</sub> is released during its production
- b) The polyester in your T-shirt was made from 1 pint of petroleum
- c) The polyester in your T-shirt released no CO<sub>2</sub> during production
- d) 100% polyester clothes should still be in fashion!

### 4. Shoes

- a) Leather tanning causes the largest impact during the life cycle
- b) 1 month of laborer's salary < sales price of the final shoe product
- c) Are never purchased by women
- d) None of the above



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# Example: Austin Energy

Emission patterns

Lets have a look

- Total 2006
  - Impact assessment
  - Normalization
- Savings 1997-2006





# Austin Climate Protection Plan

## The plan

- Make all new single-family homes zero net-energy capable by 2015. Increase energy efficiency in all other new construction by 75% by 2015.
- Require disclosure of historic energy use, facilitate and require energy efficiency improvements in existing homes and buildings at point of sale.
- Enhance incentives and requirements for Green Building program develop “carbon neutral” certification.





# Austin Climate Protection Plan

## Life Cycle Thinking considerations

- Are there trade-offs to other environmental impacts?
- What life cycle phases are included in 'Carbon Neutrality'?
- What about the existing stock?
- What about sustainable design vs. life style?



***Fact*** in the Netherlands 40% of the environmental load related to a residential building comes from energy, 60% is material related



## 10 out of 10

### 5. Car

- a) Each year Americans drive 10 times as many miles as the rest of the world's drivers combined
- b) Manufacturing accounts for 1/1000th of its life cycle energy demand
- c) Manufacturing accounts for one eighth of its life cycle energy demand
- d) Should be replaced by Hydrogen Fueled Hummers

### 6. Computer Chip

- a) Making a chip generates 4,500 times its weight in waste
- b) Computer chips are typically produced using renewable materials
- c) Computer chips are typically produced using at least 30% recycled materials
- d) A computer chip tastes much better than a potato chip



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# About LCA tools

*World leaders*

SimaPro

<http://www.pre.nl/download/manuals/SimaPro7IntroductionToLCA.pdf>

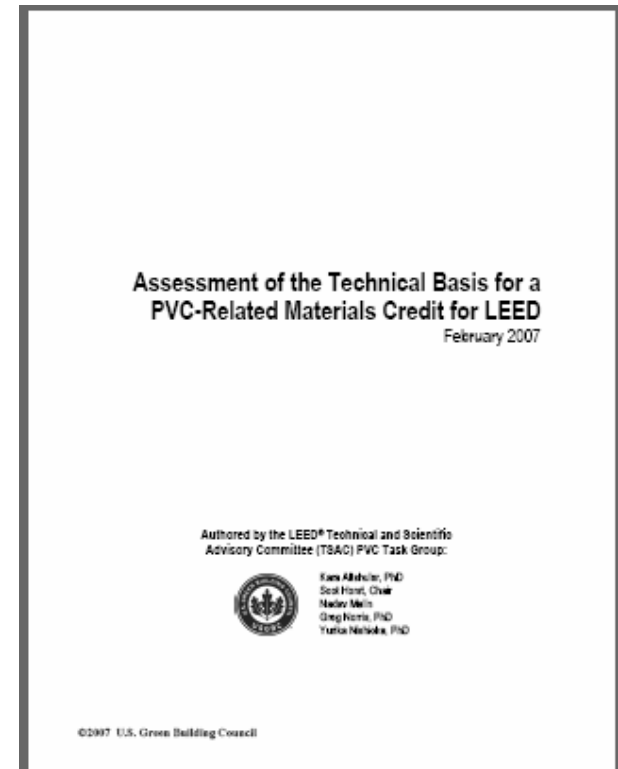
Gabi



**GaBi Software**  
PRODUCT SUSTAINABILITY



# USGBC PVC study





# USGBC PVC study

## Questions

- Data sources
- Comparisons according to [ISO 14044](#)
- Lets have a look
  - Calculations
  - Major contributions
  - Impact assessment

USGBC input Sawn timber+ avg EOL, raw, kiln dried, u=20%, at plant/RER U US



# USGBC PVC study

One comment

- <http://pvc.usgbc.org/comments.php> from the PPFA

*PPFA believes it is in the best interest of the environment for USGBC to create Task Groups to review the lifecycle of all building materials, products and applications in a fair and balanced manner. Without like Task Groups for other materials, a fair and unbiased consensus process is undermined.*





# About the science LCA

## ISO 14044

Lets have a look

- Functional unit p.20
- Normalization / weighing p.32
- 6.1 last paragraph p.44



# About LCA

## *Further reading*

ISO 14040 series on Life Cycle Assessment

ISO 14020 series on Environmental labeling

<http://therightenvironment.net/LCA.htm>

UNEP: why take a life cycle approach?

<http://therightenvironment.net/UNEPLCAapproach.pdf>

# Somewhere in Europe

1980's Preference lists

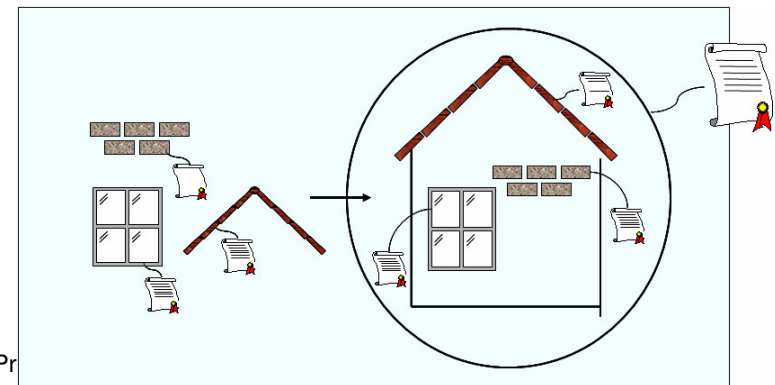
1990's Type III labeling over the last 10 years

2000 First LCA based Building model : Eco-Quantum

2004 CEN Mandate 350 Sustainable Construction

2005 NL and French standards

2009 EU EPD standards for building products





# Read the disclaimer

Read any LCA report carefully with this in mind:

What is it all about

- What is the question being answered?
- What is the functional unit?

What was left out

- Which life cycle phases are not included?
- Which impact categories are not included?
- Who is not involved?



## 10 out of 10

### 7. Computer

- a) 2/3 of US computers are left on every night and weekend
- b) Over 350 hazardous materials/chemicals went into the manufacturing
- c) Over 1000 hazardous materials/chemicals went into the manufacturing
- d) Self aware computers already control 75% of the U.S. government

### 8. Cheeseburger

- a) A cow metabolized 15 lb of corn into muscle for a 1/4 lb burger
- b) The growing of feed for beef cattle accounts for 10% of the world's pesticide use
- c) A cheeseburger can take 700 gallons of water to make
- d) I'm not sure that a cheeseburger even contains beef from a cow



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# What do I want to work on

- Accepted US/TX database
- Building model with US/Austin reference buildings
- Engage primary stakeholders
- University program and/or students that want to contribute to the bigger picture of the Sustainability framework by getting grip on parts?

To empower decision makers with resulting information

INDUSTRY BLOG

## How to spend all that infrastructure money from the Obama stimulus package in a sustainable way?

by **Joep Meijer** on February 13, 2009 07:01 PM



With the new administration, the green building industry cries victory and LEED is getting ready to help all federal and government agencies spend money on making buildings more energy efficient. That's great – but what about all that money that is going to be poured into concrete, steel and asphalt in upgrading our existing infrastructure and creating more mass transit infrastructure? Who will make sure that the money is not just spent, but that it is spent on what works, especially from the point of view of sustainability? There is no LEED for transportation projects, after all.

If we are going to inspire and influence this administration, we should make certain that sustainability attributes are part of every request for proposal and contract

theRightenvironment





# LCA based Sustainability Performance Metrics

What would a primer list look like for environmental sustainability?

- GHG
- MJ
- Water
- Resources
- Recycling/reuse ability and performance
- Human health
- Ecosystem health



# What lies ahead?

Integration of

- Technical (will it work?)
- Economics (will it provide income?)
- Environment (will it enhance nature?)
- And Social capital (will it empower people?)

multi-criteria modeling



# Discussion

What ...

*...can*

*...will*

*...should*

*...want to*

UT and you do?



## 10 out of 10

### 9. Aluminum Can

- a) Recycling it takes only 5% of the original energy required to produce it from natural resources
- b) Bauxite mining disrupts more surface area than mining other ore
- c) Crushing an aluminum can against my forehead gets easier with each beer I drink
- d) All of the above

### 10. Daily average American's consumption of total 'stuff' is

- a) 12 pounds of stuff
- b) 120 pounds of stuff
- c) 240 pounds of stuff
- d) My head hurts... quit asking me questions!



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