Life Cycle Assessment: Codes, Standards & Rating Systems
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Weighing material options
By attribute?
- regional
- recycled content
- short-term renewability
- durability
- or...

By environmental performance ➔ LCA
- Air pollution
- Acid rain damage
- Climate change
- Water pollution
- Resource depletion

Business Case for LCA in Building Products & Design
- Climate change ➔ international accords, carbon offset and trading programs
- LCA coming into codes, standards & rating systems
- Seen as answer to growing green washing problem
  ➔ LCA-based Environmental Product Declarations (EPDs)
- Requirements for EPDs could become trade barriers
- Industry will have to adapt or lose market share
- Large corporations well positioned to deal with the shifts
  ➔ What about the small and medium sized companies?
- Corporate sustainability programs
- Role of Walmart and other major chains
Increase in eco-labels
(495 in US, Europe & Asia & growing)

Slide courtesy of D. Allen, US EPA

Putting Labels in Perspective

Eco Labels
Type I Verified
e.g., EcoLogo
Type II Unverified
Self Declaration

Type III Verified Environmental Product Declarations (EPD)
Climate Declarations
Carbon Foot-Print

Life Cycle Assessment (LCA)
ISO 14025

LCA-based EPDs emerging as the dominant label

Can be a company, an Association, or a 3rd party provider

EPD Process

Program Operator
Product Category Rules (PCR)
Repository
LCA
EPD
Peer Review

Review Panel
EPD Verification
Validation period usually 3 years

Tracking Flows: The Inventory Step

MATERIAL ACQUISITION
Emissions to Air
Water
Land

Raw Materials Acquisition
Material/Metalworking
Products/Assemblies

BUILDING CONSTRUCTION
(manufacturing)

OCCUPANCY
(Use, reuse, maintenance)

DEMOLITION/DISPOSAL
Recycle/Reuse
Waste Management

Material sources
Energy
Water
Impact Assessment Phase

**Inventory**

- fossil fuel depletion
- global warming potential
- ozone depletion
- acid rain
- toxic releases → air/water/land
- etc.

**Mid-point impact indicators**

Impact Assessment (Valuation)

**THE GOAL:** to measure ultimate impacts on human and ecosystem health

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In the Case of Energy...

Even source energy doesn’t get it all

End use energy estimates just one part of the story

The rest of the story is the energy to make and move energy — called pre-combustion in LCA.

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LCA Limitations

LCA is not the answer to all problems

E.g., does not readily handle such issues as:

- Indoor environmental quality
- Uncertainty and risk related to toxic releases
- Site specific resource extraction effects

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The LCA Tool Kit

*For LCA practitioners* — SimaPro, GaBi, Umberto

**LCA in the background**

- Level 1 — Product Focus
- BEES: free download from NIST
- Level 2 — Assembly Focus
- ATHENA EcoCalculator: free download
- Level 3 — Whole Building
- ATHENA Impact Estimator

Developed primarily to meet the needs of LCA into rating systems

For use at conceptual building design

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The Uncertainty Factor

**MATERIAL ACQUISITION**

- Raw Material Acquisition
- Manufacturing
- Products / Assemblies

Occurs over a relatively short time frame (e.g. 18-36 months)

**DEMOLITION / DISPOSAL**

- Products / Materials
- Recycle / Reuse
- Waste Management

Is likely to last many years (50-100 or more)

Focus on relative effects, not absolute numbers!

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LCA in labels, codes, standards and rating systems

[LEED logo]

[IGCC logo]

[GREEN GLOBES logo]
Codes and Standards

- ASTM: Product Category Rules for Environmental Declarations for Building Products and Systems
- ASTM: Working Group on a standard practice for whole building LCA
- NAHB/ICC700: National Green Building Standard™
- ASHRAE/USGBC/IESNA Std 189: High-Performance Green Buildings
- ICC green building code (IgCC)
- California Green Building Code

How LCA is being incorporated

- IgCC – whole building LCA
  - Alternative compliance path (Project Electives)
  - Improve performance of final design versus a baseline design
- ASHRAE 189.1 – whole building LCA
  - Performance option similar to IgCC
- ASTM Working group
  - Objective: a Standard Practice for LCA at the whole building level
  - Set criteria to ensure a level playing field irrespective of tool used
- California Green Building Code
  - Currently shifting toward IgCC approach

But confusion reigns…

- Lack of understanding and confusion about LCA
- Industry jockeying for advantage
- Environmental organizations also in the race
- Competition between LCA and non-LCA tools that adds to confusion
- Perceptions of competition where none exists

Options for LCA in Rating Systems

Option 1: Pre-rate assemblies
- LCA in background
- Limited demands on design teams
- More demands on the rating organization
- Focus on materials
- Simplistic

Option 2: Decisions based on LCA
- Design teams may use whole building LCA tool(s)
- Could combine embodied and operations effects
- Difficult to verify
- High educational value

Option 3: Whole building LCA
- High demands on design teams
- Need benchmarks (onus on rating system orgs.)
- Combine embodied and operations effects
- Supports optimization of envelope vs. operations

LCA in the rating systems

Green Globes
- Adopted assembly ranking approach
- GBI funded prototype tool (ATHENA EcoCalculator)
  - Points based on performance relative to benchmarks for each of several measures (e.g., global warming potential)
  - Included in Green Globes ANSI standard

LEED
- Also adopted assembly ranking approach
- Using ATHENA EcoCalculator as basis for credit calculator
  - Same basic approach to allocating points

What about operating energy?

- LCA credits currently deal only with materials
- Operating energy continues to be covered in separate areas of Green Globes and LEED
- May make points in LCA and not do so well in energy area, or vice versa
- Operating energy can be combined with embodied effects when we shift to whole building LCA
Rating System Credit Calculators

- Start with the selection of EcoCalculator assemblies
- Submit the spreadsheet (GG) or summary table (LEED)
- The Credit Calculators will then:
  > apply life cycle impact category weightings;
  > compare the results to the reported averages by impact measure within assembly categories;
  > adjust for impact measure weights and relative importance of assembly categories;
  > provide an LCA score; and
  > calculate the number of possible rating system points

Simple to Use

- Results in spreadsheet form
- Users only fill in yellow cells
- Instant answers

Whole Building Context

- Results on a per unit area basis (e.g., per ft²)
- Estimates based on much larger areas, e.g., 1000 linear feet of wall
- Components and loadings typical for central U.S.
- Owner occupied office buildings, 60-year lifespan
- Affects maintenance and repair/replacement schedules
- Other specific assumptions:
  > Window to wall ratio
  > Concrete strength and fly ash content
  > Gypsum board type and thickness with latex paint
  > Live load for all intermediate floors, columns & beams, roofs
  > Bay sizes and column heights
  > External wall thicknesses depending on construction system
  > Stud size/strength and spacing
  > Sheathing and decking materials
11 tonnes CO2e cradle to grave 60 year life

2x6 wood stud wall with brick cladding
Wood structural panel sheathing
R-19 batt insulation + PET membrane
Gypsum board + Latex paint

2x6 wood stud wall with vinyl cladding
Wood structural panel sheathing
R-19 batt insulation + PET membrane
Gypsum board + Latex paint

EcoCalc Versions
- Current
  - ASHRAE Zone 3 averages
  - ASHRAE Zone 6 averages
    - 8 Canadian regions
      - Vancouver, Calgary, Winnipeg, Toronto, Ottawa, Montreal, Quebec, Halifax
    - 7 US regions
      - Atlanta, Minneapolis, Orlando, Pittsburgh, New York, Los Angeles, Seattle
- Coming
  - other SW and central US regions

All with hi-rise and low-rise versions