

LCA for Design of Greener Buildings

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Outline

- Why life cycle assessment?
- LCA from a building industry perspective
- LCA-based tools for the building sector
- Picking the right tool
- Whole building LCA — a case study
- LCA in rating systems

Green is a confusing topic

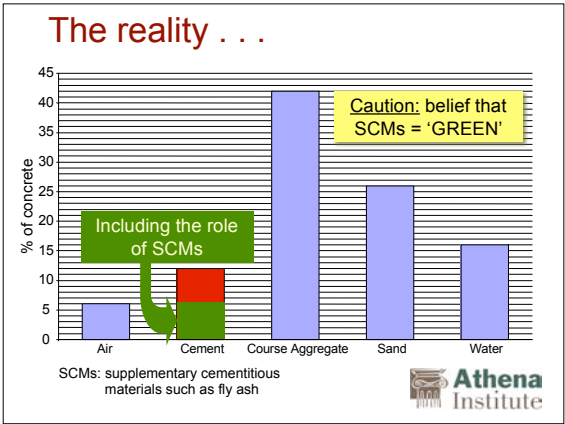
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Take cement as an example

- ◆ Approximately 1 – 1.25 tons of CO₂ for every ton of clinker
- ◆ Each ton of Portland cement takes about:
 - » 4 million BTUs to produce
 - » 3500 lbs of raw material
- ◆ Portland cement production accounts for:
 - » 5% of all carbon dioxide emissions world wide

... people tend to associate such facts directly with concrete

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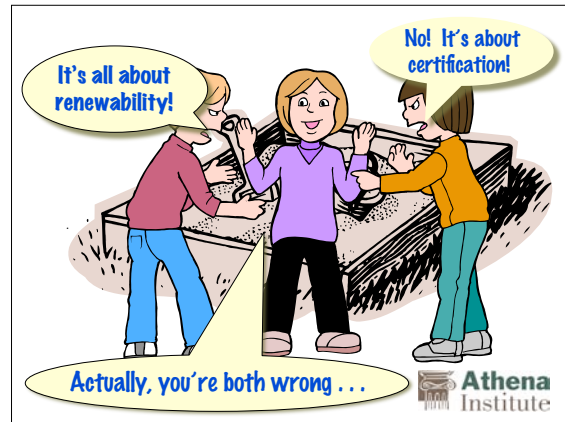


Materials and resources credits are especially weak in rating systems . . .

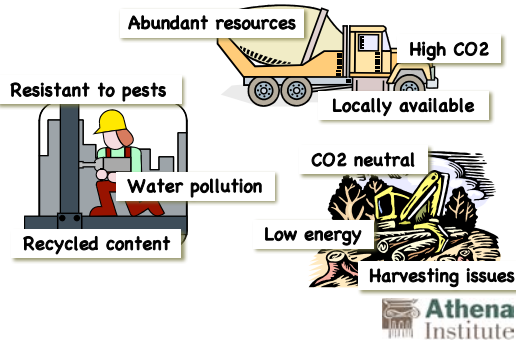
... and very controversial

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What about wood?

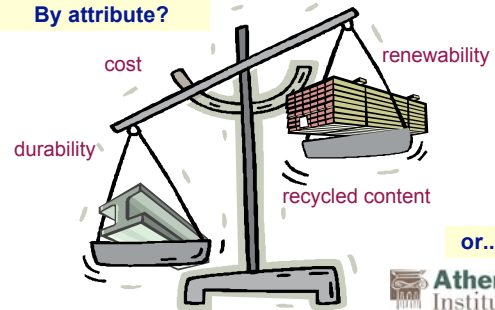


Materials selection is all about trade-offs!

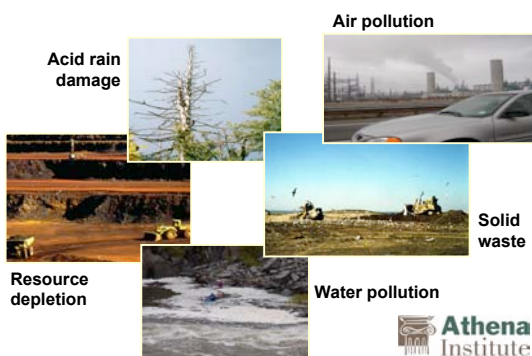


Weighing Material Options

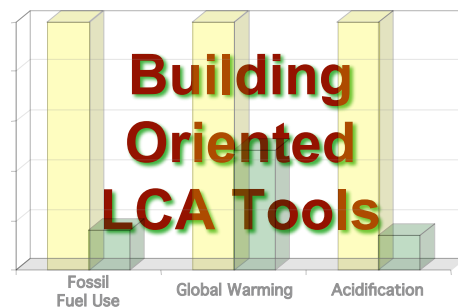
By attribute?



By environmental performance → LCA



Building
Oriented
LCA Tools



Simple tool classification system

Level 1 — product comparison tools and info sources

> [BEES, SimaPro, GaBi, Umberto], GreenSpec

Level 2 — whole building design or decision support

> Energy Plus, Radiance, [Athena EIE]

Level 3 — whole building rating or assessment systems

> Green Globes, LEED, NAHB Guidelines

LCA tools

LCA practitioners tools



NIST

BEES Model



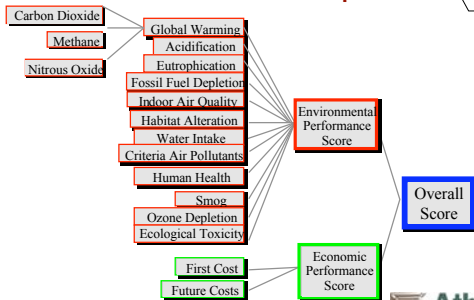
LCA-based Level 1 product comparison tool for use at the specification/procurement stage

- ◆ Focuses on environmental effects and life cycle costs
- ◆ Provides detailed results for a wide range of impact indicators
- ◆ Uses weighting factors to generate environmental and economic scores



NIST

Environmental impacts



the Athena Environmental Impact Estimator

LCA-based Level 2 whole building tool for use at the conceptual design stage

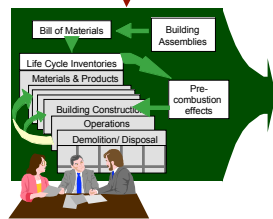
- > Shows environmental effects of changes in shape, design or material make-up of a building
- > A range of indicators without weighting
- > Allows designers to optimize operating+embodied energy effects over the complete building life cycle



the Athena Estimator



Regional
Electricity Grids
Transportation & Product Technologies
Maintenance Schedules



INVENTORY

- Raw Materials
- Energy Use by type
- Water Use
- Emissions to Air
- Emission to Water
- Solid Wastes

SUMMARY MEASURES

- Energy Use
- Global Warming Potential
- Air Pollution
- Water Pollution
- Resource Extraction Effects
- Solid wastes

... informed environmental choices

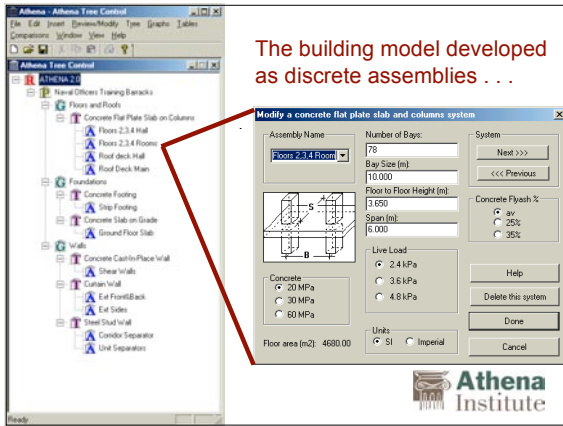


Primary energy → fossil fuels

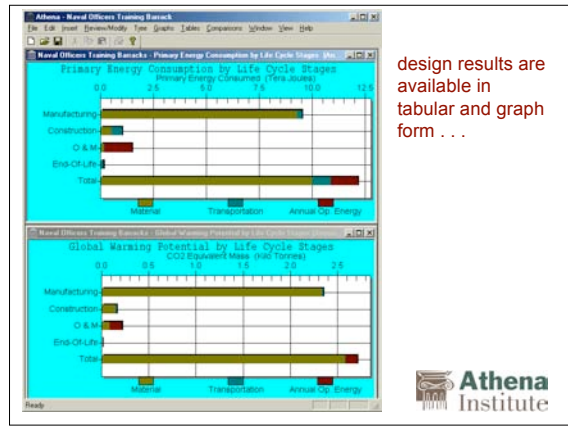
Value	Unit	Energy Type	
0.00000	kWh	Electricity	per year
2401.286636	m3	Natural Gas	per year
0.000000	l	LPG	per year
0.000000	l	Heavy Fuel	per year
0.000000	l	Diesel	per year

add operating energy estimates

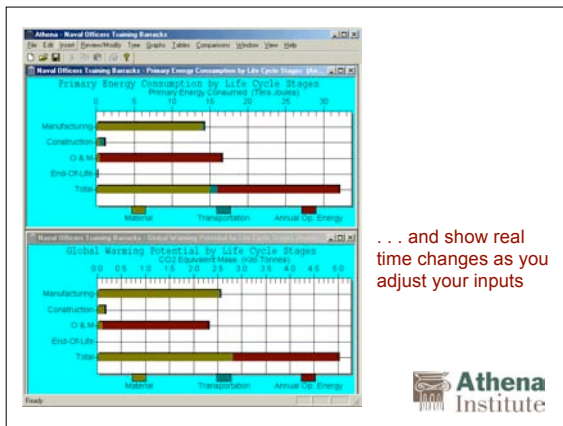




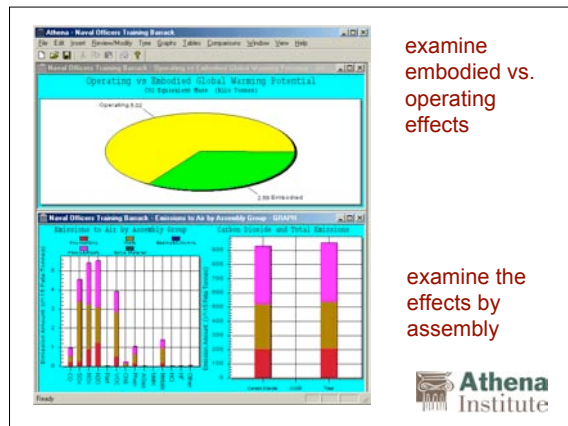
The building model developed as discrete assemblies . . .



design results are available in tabular and graph form . . .



. . . and show real time changes as you adjust your inputs



examine embodied vs. operating effects

examine the effects by assembly



Picking the right tool

*fair comparisons!
design stage?
type of data?*

Functional equivalence . . .

- ◆ Want to compare functionally equivalent products
- ◆ Choice of one product → other choices
- ◆ Differences in O & M implications
- ◆ Misleading comparisons more likely for structure and envelope products

. . . be cautious about product comparisons

Ensuring fair comparisons



The right tool for the task

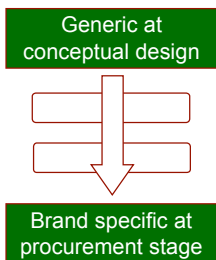


Conceptual Design



Specification/Procurement

What kind of data?



LCA in Rating Systems



LCA integration options

Award points for:

1. Selecting highly ranked products or assemblies from a pre-rated list
2. Making decisions based on the use of an LCA tool
3. Achieving specific performance levels relative to defined impact indicators at the whole building level

LCA into LEED project

- ◆ Objective
 - » Report to the LEED Steering Committee recommending how best to implement LCA-based credits within LEED
- ◆ September 2004 kick-off meeting
- ◆ Established the basic principles
 - » Level Playing Field – consistent, objective
 - » Build off what exists – don't reinvent wheels
 - » Practical LCA tools for the industry
- ◆ Working Groups
 - » Goal and Scope
 - » Technical LCA issues
 - » Weighting of impact measures

Short term focus

Credit Category	LEED Products					
	NC	EB	CI	CS	H	ND
Site Selection						
Water Efficiency						
Energy & Atmosphere						
Materials & Resources						
Indoor Environmental Quality						



LCA in Green Globes

- ◆ Basically LCA education credits at present
 - » encourage selecting materials with the lowest life cycle environmental burden
 - » but no firm benchmarks or measures
- ◆ Work underway on the assembly ranking approach
 - » for consideration by ANSI technical committee
 - » Athena Environmental Impact Estimator used for basic LCA of assemblies
 - » points to be awarded based on performance relative to benchmarks for each of several measures (e.g., global warming potential)



In conclusion

- ✓ Take the environment into account early in the design process
- ✓ Focus on true environmental performance measures
- ✓ Look at the entire life cycle of a building
- ✓ Make functionally equivalent material comparisons
- ✓ Recognize and take account of trade-offs

**BE WARY OF SIMPLISTIC ANSWERS
TO COMPLEX QUESTIONS**



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WELCOME

At the Athena Institute, we believe better information and tools are critical to achieving a sustainable built environment. We also believe a Life Cycle Assessment (LCA) approach to sustainability is the only way to create a level playing field for the vast array of building materials in use.

Over the past decade, the Institute has developed a worldwide reputation in the field of sustainable building.

www.athenaSMI.ca

