

High Performance Buildings: Infrastructure, Commercial, Residential

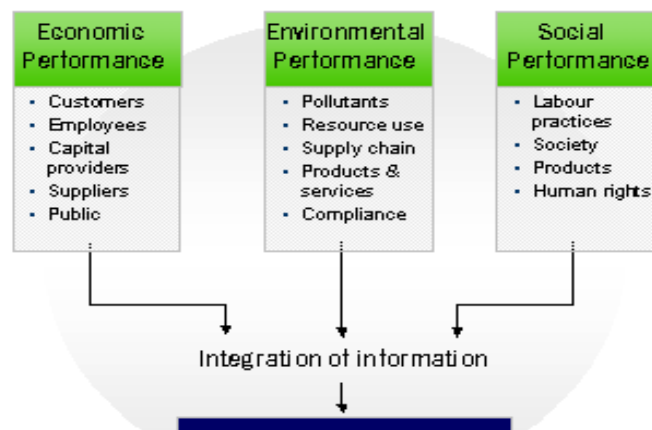
- What is unsustainable about our current construction practices?
- What makes one building more sustainable than another?

1. One way to frame it: **Triple Bottom Line**, which comes from the **three pillars of sustainability**

a) **Triple Bottom Line** - simultaneously optimize

- (1) Environmental factors – all the things we’ve been talking about
- (2) Social factors – Building a housing development that requires residents to drive everywhere; building a gated community? Building an incinerator that emits controversial emissions without consulting or educating the community; building a commercial building that doesn’t fit in with the current zoning
- (3) Economic factors – Highest value: best quality for lowest cost; includes all the economic costs throughout the life of the project {life cycle costs} – costs of municipality needing to add schools, sewers, police, libraries, etc.

The Triple Bottom Line Approach



Another way to frame it: Life Cycle Analysis – will look at costs and env’l impacts quantitatively

- b) Resource Use – aim for materials that exert least drain on natural resources – recyclable, durable
- c) Energy use – aim for materials that require minimum energy throughout all life phases
- d) Water use – aim for minimal throughout life phases
- e) Waste – aim for minimal throughout life phases; minimal pollution generation

Some Gee Whiz Facts:

Consider: Economic Input-output Life-cycle Assessment of U.S. Residential Buildings

J. Infrastruct. Syst., Vol 8, Is 4, pp. 132-138 (Dec 2002) Luis Ochoa,¹ Chris Hendrickson,² M.ASCE; and H. Scott Matthews³

Abstract: We estimate the building resource requirements, electricity and energy used, greenhouse gas releases, hazardous waste generated, and toxic air releases for the construction, usage, and demolition of typical U.S. residences in 1997. Within the three phases, usage (54% of economic activity) is the largest consumer of electricity (95%) and energy (93%) and the largest emitter of greenhouse gases (92%), while the construction phase (46% of economic activity) is the largest air toxics emitter (57%) and contributes 51% of hazardous waste. The disposal phase contribution is negligible in all of these categories. **From the standpoint of the entire U.S. economy, residential buildings account for 5.3% of the Gross Domestic Product, 38% of electricity consumption, 26% of energy consumption, 24% of greenhouse gas emissions, 26% of hazardous waste, and 12% of toxic air emissions.** We comment on possible remedial actions—including some current public policies—to address environmental impacts.

Pre-construction & construction: 46% economic activity, 57% toxic emissions, 51% haz waste

Usage – accounts for 54% of economic activity, 95% electricity, 93% energy, 92% GHG

Demolition – negligible

Consider: Waste from building a typical home

Source: ([http://www.ey.com/global/ccr.nsf/Images/3FBC83FB265D3EC985256EE20049497F/\\$FILE/Slide4.gif](http://www.ey.com/global/ccr.nsf/Images/3FBC83FB265D3EC985256EE20049497F/$FILE/Slide4.gif))

"Typical" Construction Waste Estimate 2,000-sq ft home		
Material	Weight (lbs)	Vol (cu yds)*
Solid Sawn Wood	1,600	6
Engineered Wood	1,400	5
Drywall	2,000	6
Cardboard (OCC)	600	20
Metals	150	1
Vinyl (PVC)**	150	1
Masonry***	1,000	1
Hazardous Materials	50	-
Other	1,050	11
Total	8000	50

*Volumes are highly variable due to compressibility & captured air space in waste materials.
 **Assuming three sides of exterior clad in vinyl siding.
 ***Assuming a brick veneer on home's front facade.

Guidelines for Assessing and Choosing Materials (http://www.rainforestinfo.org.au/good_wood/env_imp.htm)

Methods for assessing and choosing materials are based on the following guidelines:

1. Environmental factors
2. Local materials and transport needs (savings)
3. Needs of occupants of dwellings
4. Need for appropriate building design for marketing
5. Need for financial viability/affordability
6. Need to make best use of current technology, through the Building Material Assessment System (see above).

Each material is assessed at five stages of its life:

- mining/extraction
- manufacture
- construction
- use
- demolition.

The assessment is covered by 14 different parameters:

- a) The damage to the environment during mining or harvesting of the basic material.
- b) How much damage in relation to the quantity of materials (what else is disturbed or damaged?).
- c) The source, size, or renewability of the basic material.
- d) The recycle content.
- e) Waste residue, solid or liquid, in production.
- f) The air pollution due to manufacture and production.
- g) The embodied energy
- h) The energy consumed during transportation to site of usage.
- i) The energy consumed on-site for erection or assembling.
- j) The on-site waste and packaging.
- k) The maintenance required during the life-cycle.
- l) The environmental impact during the life-cycle (ie, toxic emissions).
- m) The energy and effects associated with demolition/disposal at the end of the life-cycle.
- n) The recyclability of the demolished/dissembled material.

NB: Each parameter is assigned a weighting between 1 and 5, and all the weightings must total 42. This method allows users to stipulate any personal priorities. The weightings can be altered according to the philosophies of the client.

To reduce the total amount of materials consumed and their environmental impact:

(<http://www.greenhouse.gov.au/yourhome/technical/fs30.htm>)

- Make more efficient use of existing materials.
- Minimise the amount of waste.
- Use materials with least environmental impact.
- Consider both operational and whole lifecycle performance of materials and designs.
- Use fully recycled materials or materials with recycled content.
- Re-use whole buildings or parts thereof to reduce consumption of new materials.
- Choose materials with a lifespan equivalent to the projected life of the building.
- Design to extend building lifespan (current average 50 years - aim for 100+).
- Design and build for de-construction, re-use, adaptation, modification and recycling.
- Encourage development of new, efficient, low impact materials and applications by creating demand.
- Consider how and where the materials are sourced and the impacts this causes.
- Minimize the energy used to transport materials by using locally produced material. Use of lightweight material where appropriate also reduces transportation energy.
- Minimize the energy used to heat and cool the building by using materials that effectively modify climate extremes.
- Understand how chemicals used in the manufacture of some materials might affect your health.
- Minimize or eliminate emissions during use and manufacture.

Other resources:

Your home Technical Manual (Australia)

<http://www.greenhouse.gov.au/yourhome/technical/index.htm>

<http://www.greenhouse.gov.au/yourhome/technical/fs34a.htm>

Natural Building Colloquim Southwest

<http://www.networkearth.org/naturalbuilding/overview.html>