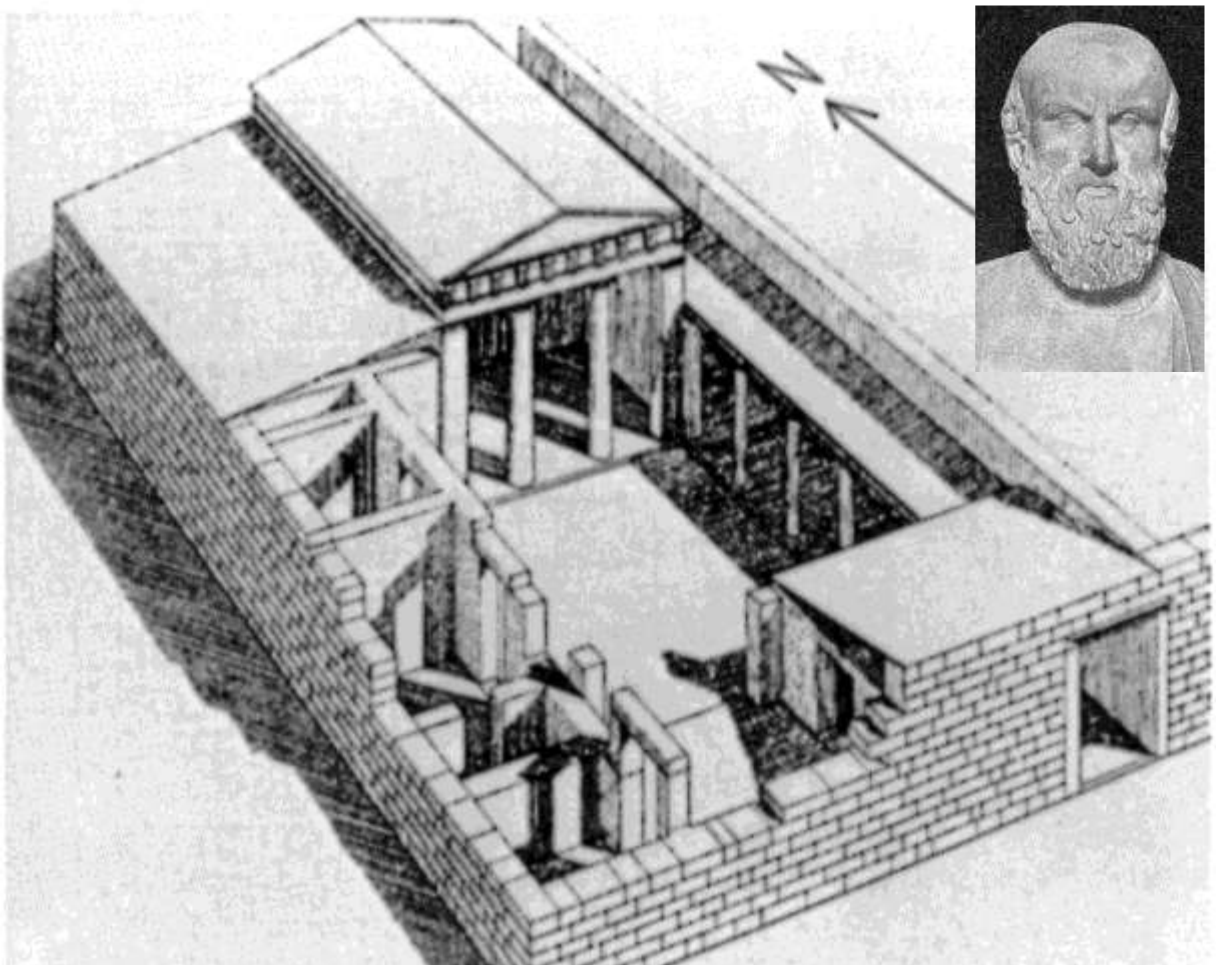

Pat Borer
AECB 2012

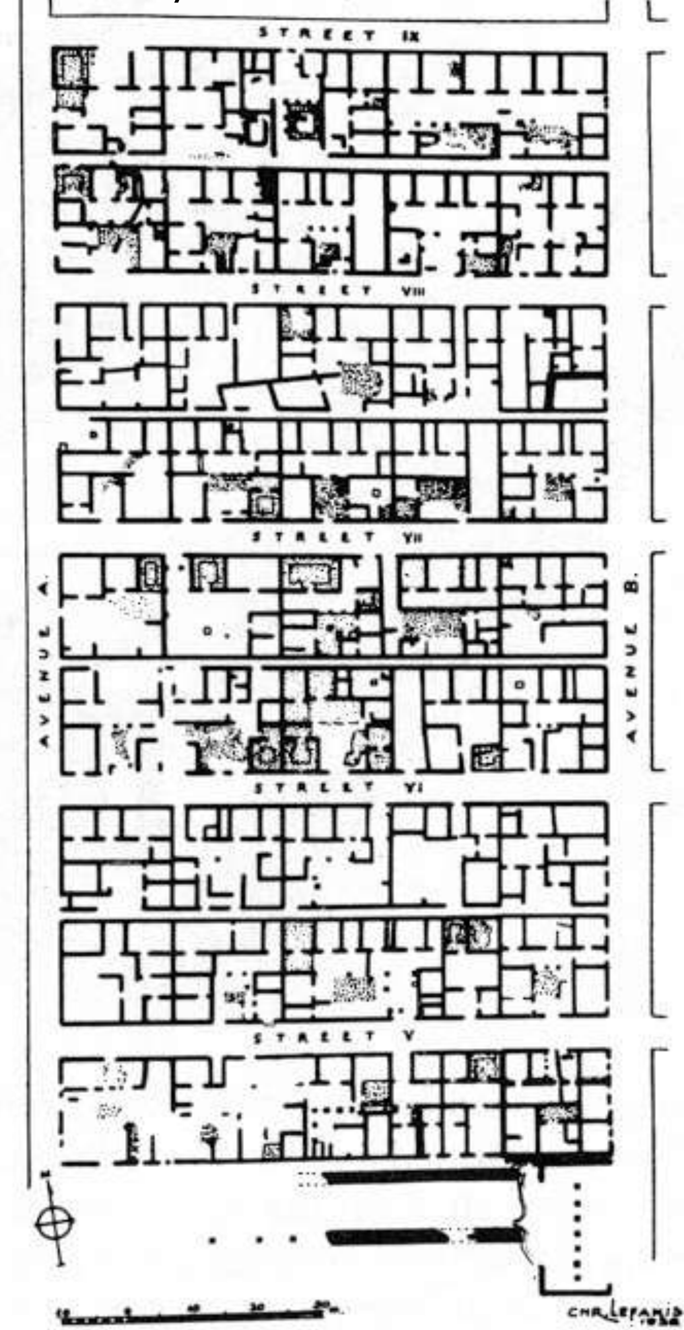
Passive solar 500 BC

"Only primitives & barbarians lack knowledge of houses turned to face the winter sun." Aeschylus C 500BCE



Butti & Perlin 1981

Olynthus new town



Ignoring passive solar, 2012 AD

Technology (the use of fossil fuel) has enabled us to continue to build like ‘primitives and barbarians’

A passive solar garage

New housing in my village - with solar water heating (it’s in Wales)

Ignoring passive solar, 1976 AD

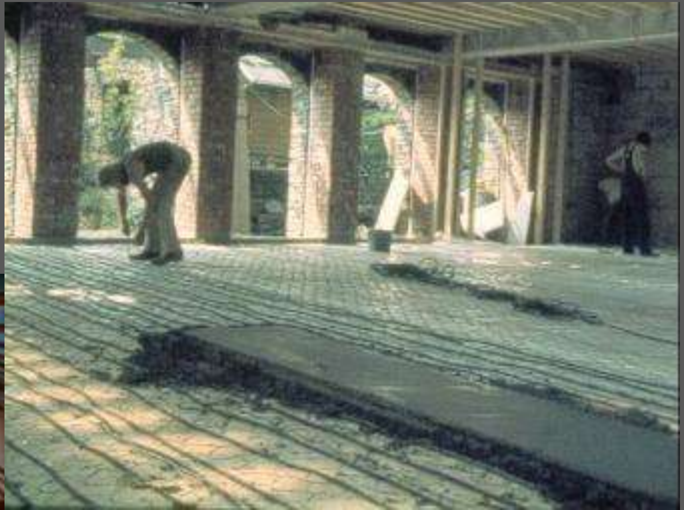
Technology (the use of insulation, MVHR, etc.) has enabled us to turn our back on the sun – for heating and delight...and we didn't consider materials

- 1976 CAT Wates Conservation House. (Peter Bond Architect)
- 10.1kWh/(m^2.a) – measured.
- 450mm insulation, quad plain glass windows, MVHR, heat pumps. U-values 0.075W/m^2K

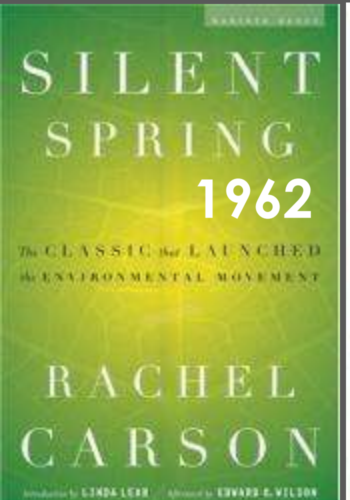
CAT in the1970s and 80s

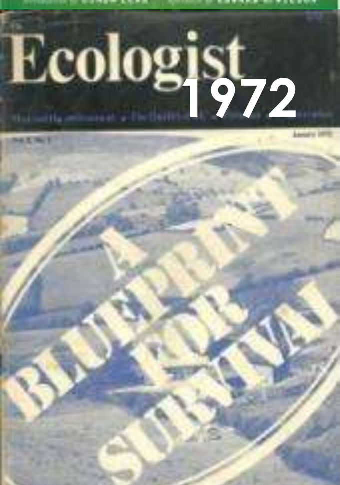
- Energy is everything

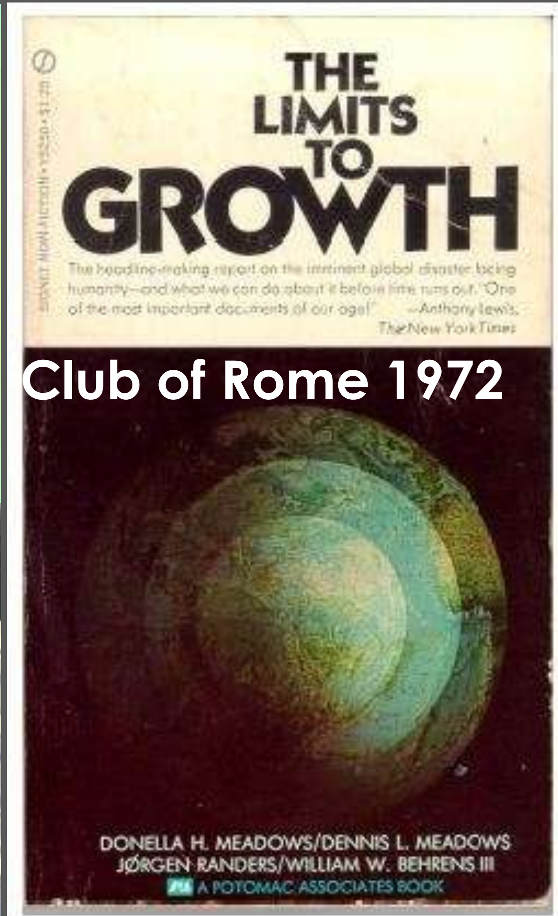
Plastics foam insulation, cement concrete, treated timber, PVC.

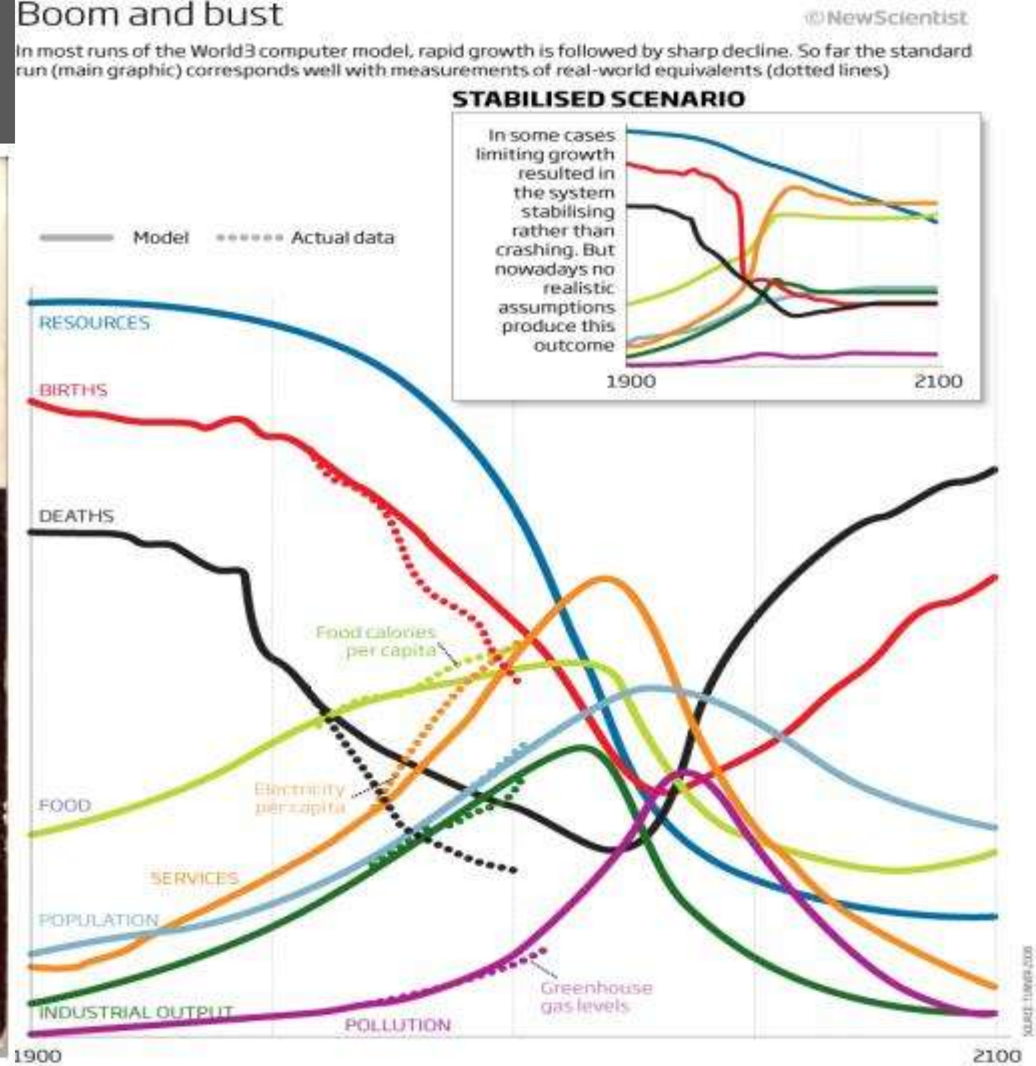


So that's my worry...









...with the amazing success that is PH, should we not try and do same for materials, etc.

It is all about poisons...

REACH

EU Registration, Evaluation & Authorisation of Chemicals

“There are some 140,000 different chemical substances involved. The regulation is not only applicable to stand-alone chemicals or those in compounds, but also to chemicals in consumer products ….In addition, the ECHA must be notified of products containing more than 0.1% of substances of ‘very high concern’, even if no release is involved.”

Boric acid	233-139-2, 234-343-4	10043-35-3, 11113-50-1	2010/06/18	Toxic for reproduction (article 57 c)	ED/30/2010		Details
Sodium chromate	231-889-5	7775-11-3	2010/06/18	Carcinogenic, mutagenic and toxic for reproduction (articles 57 a, 57 b and 57 c)	ED/30/2010		Details
Acrylamide	201-173-7	79-06-1	2010/03/30	Carcinogenic and mutagenic (articles 57 a and 57 b)	ED/68/2009		Details
Lead chromate molybdate sulphate red (C.I. Pigment Red 104)	235-759-9	12656-85-8	2010/01/13	Carcinogenic and toxic for reproduction (articles 57 a and 57 c)	ED/68/2009		Details
2,4-Dinitrotoluene	204-450-0	121-14-2	2010/01/13	Carcinogenic (article 57a)	ED/68/2009		Details
Anthracene oil, anthracene-low	292-604-8	90640-82-7	2010/01/13	Carcinogenic[3], mutagenic[3], PBT and vPvB (articles 57a, 57b, 57d and 57e)	ED/68/2009		Details
Lead chromate	231-846-0	7758-97-6	2010/01/13	Carcinogenic and toxic for reproduction (articles 57 a and 57 c)	ED/68/2009		Details
Tris(2-chloroethyl)phosphate	204-118-5	115-96-8	2010/01/13	Toxic for reproduction (article 57c)	ED/68/2009		Details

(Ruifrok, P. 2012)
(REACH. 2012)

SIN List

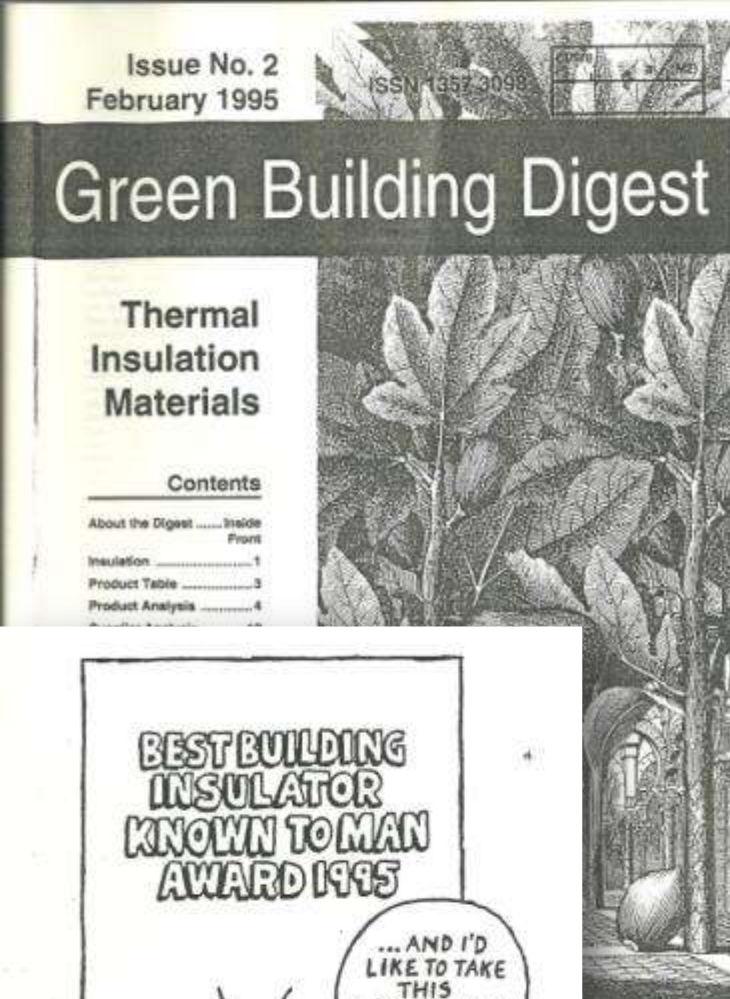
Substitute it Now! (SIN 2012)

- 378 chemicals identified as ‘Substances of Very High Concern’ .....“fast track to a toxic-free world”
- Styrene below

8.	100-42-5	Styrene	Hide info

Name	Styrene
CAS Number	100-42-5. *Source: ESIS*
EC Number	202-851-5. *Source: ESIS*
Synonyms	Styrol; Estireno; StyrÃ¨ne; Cinnamene; ethenyl benzene; phenylethene; phenylethylene; vinylbenzene. *Source: ESIS; EURAR 2002*
Risk phrases	R10 : Flammable; R20 : Harmful by inhalation; R36/38 : Irritating to eyes and skin.. *Source: ESIS*
Classification	R10; Xn: R20; Xi: R36/38. *Source: ESIS*
Envisaged Registration deadline	30/11/2010. *Source: ECHA*
Production volume	>1000 tonnes/year, HPV. *Source: ESIS*
(Bio)monitoring data	Yes, in air, drinking water, exhaust fumes (from incineration, industries, cars etc), in soil, sediment. In human breast milk. Styrene trimers migrate into food from polystyrene containers.. *Source: HSDB; Polzin et al 2007*
Information on uses	Manufacture of plastics (polystyrene, expandable polystyrene, ABS, resins, rubbers (polyester resins) and latexes). Produced products include packaging, electrical and thermal insulation, putty, paints, adhesives, fiberglass, pipes, automobile parts, carpet backing, drinking cups and other food-use items (1), automobile tires, plastics, waxes, paints and varnishes, adhesives, metal cleaners (2). CD cases, drinks cups, food containers and refrigerator door liners (polystyrene), home insulation, packaging material, padding inside motorcycle helmets, in car interiors (expandable polystyrene foam) (3); construction materials & boats (glass fiber-reinforced, unsaturated polyester resins) (4). *Source: KEMi; Vodicka et al 2006, (1) INEOS; (2) Health Canada; (3) Shell; (4) HSDB*
Technical function of substance	M[illegible] su[illegible]
Final assessment for inclusion on the SIN List.	St[illegible] carcinogenic and mutagenic effects have been reported. It is highly toxic to aquatic species.

Indicates where a substance is used, in what kind of applications and articles it can be found.



Insulation Materials

	£	Production									Use					
	Unit Price Multiplier	Energy Use	Resource Depletion (bio)	Resource Depletion (non-bio)	Global Warming	Ozone Depletion	Toxics	Acid Rain	Photochemical Oxidants	Other	Energy Use	Durability/Maintenance	Recyclability/Degradability	Health Hazards	Other	Alert
Cellulose Fibres	n/a	·												?		
Compressed Straw slabs	n/a	·	·										·			
Cork	7.2	·											·			
Foamed Glass	16.7	⬤		·			•	•	•	•						
Glass Wool	1.0	•		•			●	•	•	●			•	•		
Phenolic Foams	n/a	⬤		•	?	?	⬤	●	●	⬤				●		HFCs, HCFCs
Polystyrene - expanded	3.1	⬤		•			⬤	●	●	⬤				·		
Polystyrene - extruded	6.2	⬤		•	?	?	⬤	●	●	⬤				·		HFCs, HCFCs
Rigid Urethane Foam	4.9	⬤		•	?	?	⬤	●	●	⬤				●		HFCs, HCFCs
Rock Wool	1.0	•		•			●	•	•	●			•	•		
Softboard	9.5	·	·										·			
Softboard + bitumen	6.7	•	·	·			·	·	·	·			·			
Urea-formaldehyde Foam	n/a	⬤		•			⬤	●	●	⬤				⬤		
Vermiculite (expanded)	n/a	•		•						●				?		
Wood-wool slabs	11.6	⬤	·	·	·		·	·	·	·			·			
Wool	10.4	·														

Key to the Table

The environmental impacts of products are rated on a scale from zero to 4 under each impact category. A blank represents a zero score, meaning we have found no evidence of significant impact in this category. Where a score is assigned, bear in mind that the scores are judged relative to the other products on the same Table.

The following symbols represent the impact scale:

⬤ .... worst or biggest impact
● .... next biggest impact
• .... lesser impact
· .... smaller but significant impact
[blank] .... no significant impact

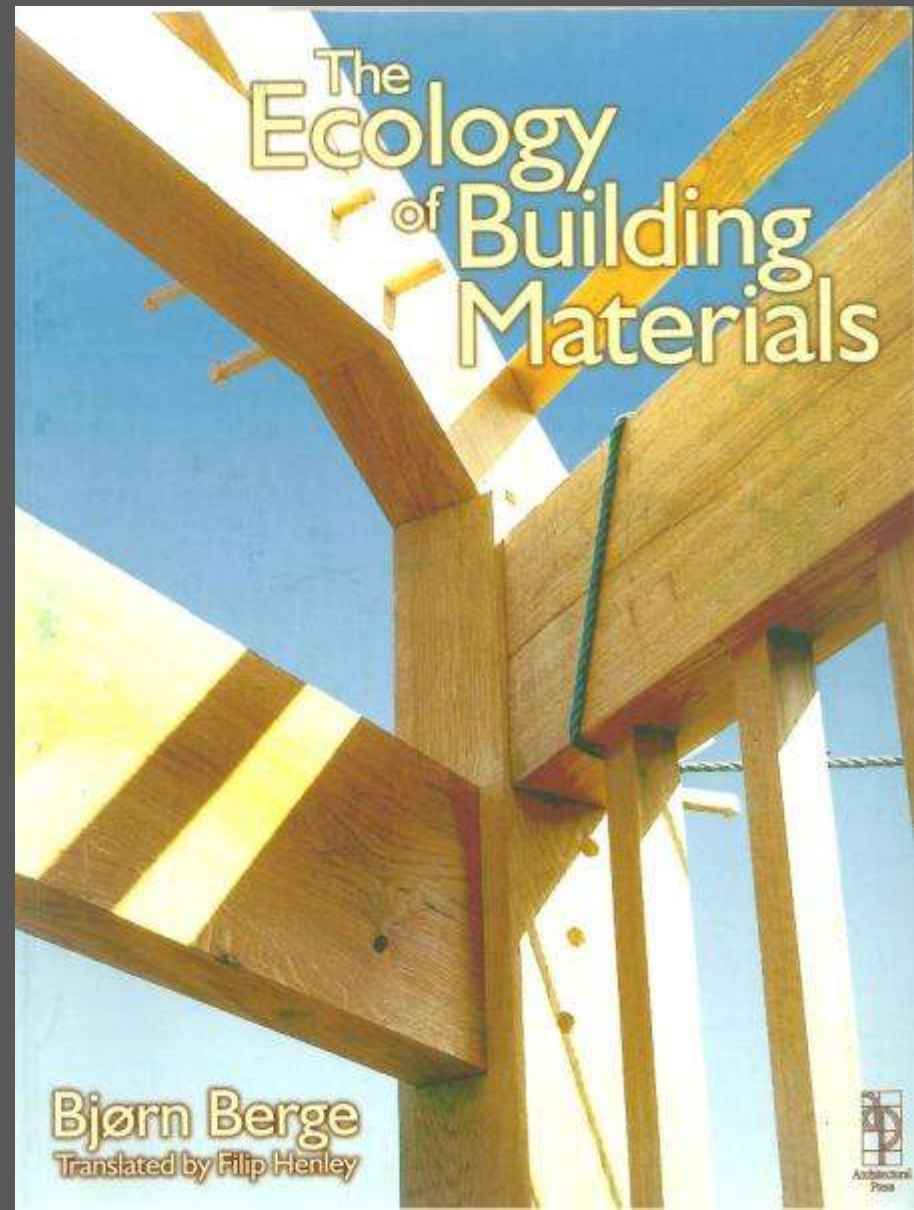
Bjørn Berge approach

"Are there environmentally friendly alternatives which can be substituted for harmful chemical substances?"

"Can raw materials from non-renewable sources be replaced by raw materials from plentiful or renewable sources?"

"Is it possible to design and manufacture reusable building materials?"

(Berge. 1995)



Bjørn Berge approach

An environmental profile, based on toxic harm, embodied energy etc., for the reader to make their own judgement.

Material	Specific thermal conductivity (W/mK)	Effects on resources: Materials	Effects on resources: Energy	Effects on resources: Water	Effects of pollution: Extraction and production	Effects of pollution: Building site	Effects of pollution: In the building	Effects of pollution: As waste	Ecological potential: Re-use and recycling	Ecological potential: Local production	Environmental profile
Still air	0.024										
Water	0.50										
Dry snow	0.06–0.4										1
Expanded perlite, untreated, 170 mm	0.045–0	1	2		2	2	1	1			1
Expanded perlite, with bitumen, 190 mm	0.055	2	2		2	1	2	3			2
Lightweight aggregate concrete blockwork (structural), 750 mm	0.210	3	3	2	2	1	1	1	✓		3(1)
Aerated concrete blockwork (structural), 400 mm	0.08	2	3	2	2	1	1	1	✓		2(1)
Foamglass boards, 170 mm	0.045	2	3	2	3	1	1	1			2
Foamglass granules, 350 mm	0.07	1	2		1	1	1	1			1
Mineral wool, 150 mm	0.04	2	2	2	2	2	2	2	✓		2
Expanded clay pellets 430 mm	0.115	1	3		2	1	1	1	✓		2
Expanded polyurethane 135 mm	0.035	3	3	3	3	1	3	3			3
Expanded and extruded polystyrene 150 mm	0.04	3	3		3	1	2	3	✓		3
Expanded ureaformaldehyde, 180 mm	0.05	3	3		3	3	3	3			3
Compressed wood cuttings 200 mm	0.05–0.	1	1	1	1	1	1	1		✓	1(2)
Porous fibreboard, unimpregnated, 200 mm	0.05	1	3	2	2	1	1	1			2
Wood wool slabs, 300 mm	0.08	2	3	3	2	1	1	2	✓		2(1)
Cellulose fibre, loose, 170 mm	0.045	1	1	1	1	2	1	3		✓	2
Cellulose fibre, matting, 150 mm	0.04	1	2		2	1	1	3			2
Flaxen matting, 150 mm	0.04	1	1		1	1	1	1			1
Slabs of peat, 150 mm	0.04	1	2		1	1	1	1			1
Straw bound together with clay, straw >100 kg/m^3, 550 mm	0.12	1	1		1	1	1	1		✓	1
Woollen matting, 150 mm	0.04	1	1		1	1	1	1(3)			1

(BRE Global 2012)

BRE The Green Guide

Straw bale (A) versus Expanded Polystyrene insulation (A+)

Element	Straw bale used as insulation
Element Number	815320029
Summary Rating	A
Climate Change	A+
Water Extraction	A+
Mineral Resource Extraction	A+
Stratospheric Ozone Depletion	A
Human Toxicity	C
Ecotoxicity to Freshwater	E
Nuclear Waste (h	
Ecotoxicity to La	
Waste Disposal	
Fossil Fuel Deple	
Eutrophication	
Photochemical O	
Acidification	B
Kg of CO_2 eq. (60 years)	-53.0

Element	Expanded polystyrene (EPS) -
Element Number	815320025
Summary Rating	A+
Climate Change	B
Water Extraction	A+
Mineral Resource Extraction	A+
Stratospheric Ozone Depletion	A
Human Toxicity	A+
Ecotoxicity to Freshwater	A+
Acidification	B
Kg of CO_2 eq. (60 years)	12.0

ASBP The Alliance for Sustainable Building Products

"If everyone does a little, we'll achieve only a little"

David MacKay: *Sustainability without the hot air.*

For example, the choice of thermal insulation

(Harris & Borer 2005)

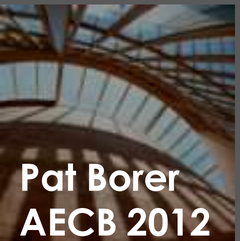
better insulation

more benign material

SOURCES OF INSULATION MATERIAL	CONDUCTIVITY λ (W/mK)												
	0.01	0.02	0.03	0.04	0.05	0.06	0.07	0.08	0.09	0.1	0.11	0.12	0.13
ORGANIC RENEWABLE			HEMP		Fibre batts & rolls								
Derived from			SHEEPSWOOL		Fibre batts & rolls								
natural vegetation			FLAX		Fibre batts & rolls								
Renewable sources			CELLULOSE		Loose fill								
Reclaimable upon demolition				CORK		Slabs, tiles, granules							
Rottable				EXPANDED RUBBER			Pipe insulation, flexible slabs						
				WOOD FIBRE		Insulation board, sheathing							
							HEMP-LIME	Rigid in-situ or blocks					
									WOODWOOL SLABS			Slabs & boards	
INORGANIC		AEROGEL	Mineral foam - insulating plasterboard dry-lining										
			MINERAL FIBRES		Fibre batts & rolls & loose fill - fibreglass, rockwool								
Derived from				MINERAL GRANULES			Loose fill, lightweight aggregates. Perlite, vermiculite						
naturally ocurring minerals					FOAMED GLASS		Blocks & slabs						
Non-renewable but plentiful							CLAY BEADS		Fired clay, underfloor fill				
										AERATED CONCRETE			Blocks
FOSSIL ORGANIC		POLYISOCYANURATE			Rigid foam boards								
Derived from		POLYURETHANE			Rigid foam boards								
chemical/oil/coal industry			EXTRUDED EXPANDED POLYSTYRENE				Rigid foam boards						
			EXPANDED POLYSTYRENE			Rigid foam boards & bead fill							
			UREA & PHENOL FORMALDEHYDE				Foam fill						

MODERNER LEMBAU (MODERN EARTH BUILDING) CONFERENCE 2002, BERLIN

- Obsession with earth building – no holistic view of construction
- For example, Martin Rauch's studio home has external rammed earth walls. When asked, he said "Well it just gets through the Building Regs"!



A short history of building – according to Peter Harper of CAT

1. Pre-modern construction: all abundant mineral and renewable materials
2. Increasing use of industrial materials, understood as a natural, desirable and inevitable progression
3. Today’s buildings: >80% concrete, steel, plastic, etc., with <20% green ‘garnishing’
4. CAT buildings: reverse this ratio, with >80% pre-modern materials and <20% ‘industrial vitamins’

(Harper, 2011)

WISE 2010

Our attempt to meet Vitruvius' requirements of:

"Commodity": Low energy, good daylighting & ventilation, etc.

"Firmness": Robust green constructions, benign materials

and "Delight"

(not) the end