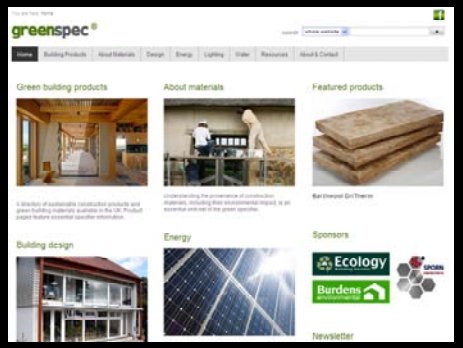

COMMENDED
The UK eWell-Being Awards 2004
www.sustainit.org

GreenSpec
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www.capem.eu

AHMM CPD
a MasterClass

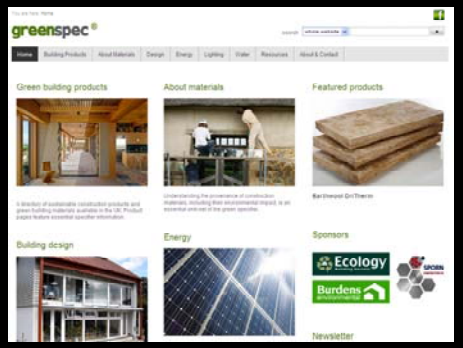
Commercial Green Construction & Materials
Embodied Carbon Footprints
Greening-Up NBS
Anti VE & D&B Substitution measures

This & contained presentations

- http://www.scribd.com/doc/52508941
- Scribd: www.scribd.com/brianspecman
- > collection >
- CPD Seminars to Architects:

- Specifications:

- Calculator Spreadsheets:



Scope

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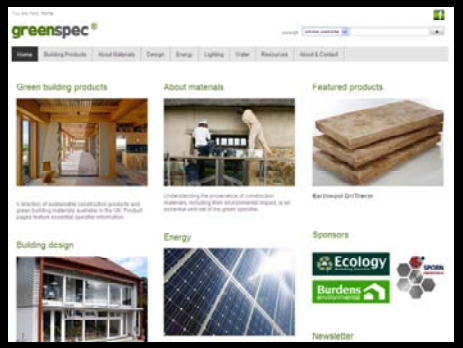
- Sensible suggestions for materials for large scale building projects
  - insulation, concrete, not timber
  - embodied carbon & carbon footprints
- how to Green-up NBS specifications
  - ensuring intentions survive VE & D&B
- How do others do it



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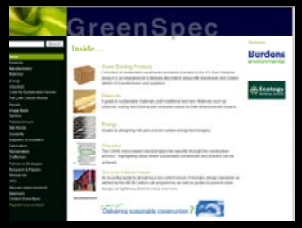
Commercial Green



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Commercial Green

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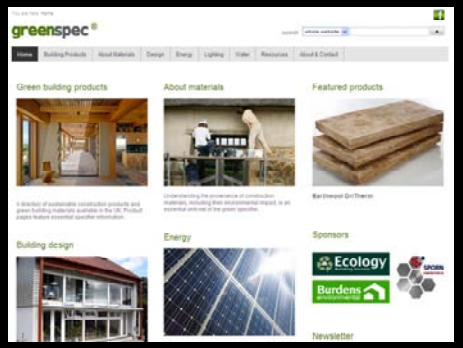

Seminars

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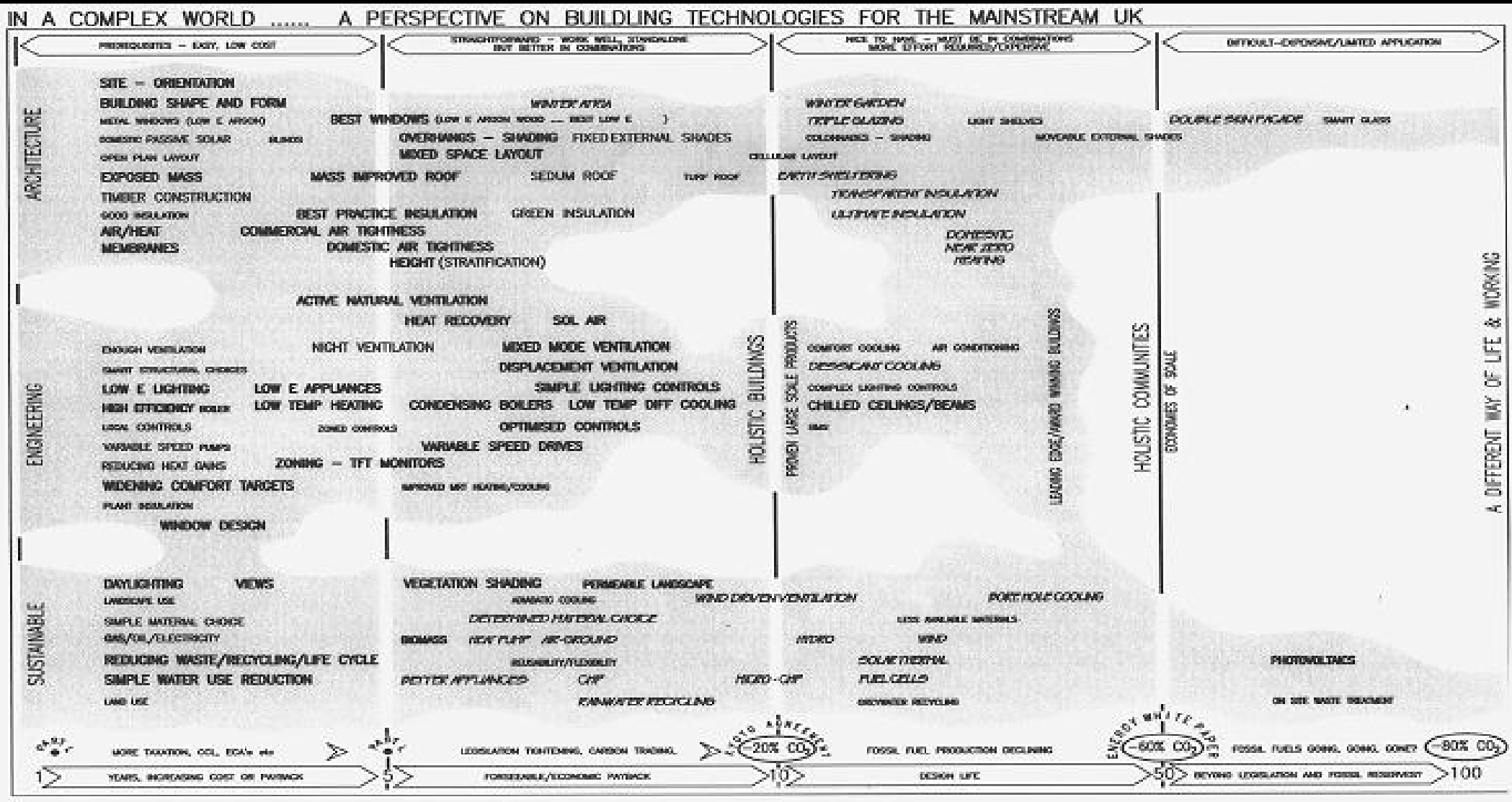
IN A COMPLEX WORLD ..... A PERSPECTIVE ON BUILDLING TECHNOLOGIES FOR THE MAINSTREAM UK



In a complex world……. A perspective on building technologies for the mainstream UK

Sustainable Engineering Architecture

Holistic Buildings

Proven Large Scale Products

Holistic Communities

Prerequisites, easy, low costs	Straightforward, work well, standalone, better communal	Nice to have, more effort required, expensive
Site – Orientation	Winter Atria	Winter Garden
Building shape and form	Best Windows: Low E Argon Wood ___ Low E	Triple Glazing
Metal windows Low E Argon	Overhangs – Shading	Fixing external Shades
Domestic Passive Solar	Mixed space Layout	Colour _____ Shading
Open Plan Layout	Mass Improved Roof	Sedum Roof
Exposed Mass	Best Practice Insulation	Turf Roof
Timber Construction	Commercial Air tightness	Cellular Layout
0.00 Insulation	Domestic Air tightness	Earth Sheltering
Air/Heat Membranes	Height (Stratification)	Transparent Insulation
	Active Natural Ventilation	Green Insulation
	Heat Recovery	Sol Air
	Night Ventilation	Ultimate Insulation
	Mixed Mode Ventilation	Domestic near-zero heat
	Displacement Ventilation	
	Simple Light Controls	
	Low Temp Diff Cooling	
	Optimised Controls	
	Variable Speed Drives	
	TFT Monitors (arrived sooner)	
	Improved ____ Heating/Cooling	

Draught Ventilation
Functional Checks
Low E Lighting
Low E Appliances
High Efficiency Boiler
Low Temp Heating
Local Controls
Zoned Controls
Variable Speed Pumps
Reducing Heat gains
Zoning
Widening Comfort Targets
Plant Insulation
Window Design

Comfort cooling
Air Conditioning
Desiccant cooling
Complex lighting controls
Chilled ceiling / beams
BMS

EcoBling Don't go there

Day-lighting
Views
Landscape Use
Simple Material Choices
Gas/Oil/Electricity
Reducing Waste/Recycling/Life Cycle
Simple Water Use Reduction
Land Use

Vegetation Shading
Permeable Landscape
_____ Cooling
Determined Materials Choices
BioMass
Heat Pump
Air-Ground
Adaptability/Flexibility
Better Appliances
CHP
Rainwater Harvesting

Wind Driven Ventilation
Hydro
Micro – CHP

Poke Hole
Mixed available materials
Wind
Solar Thermal
Fuel Cells
Greywater Recycling

Now

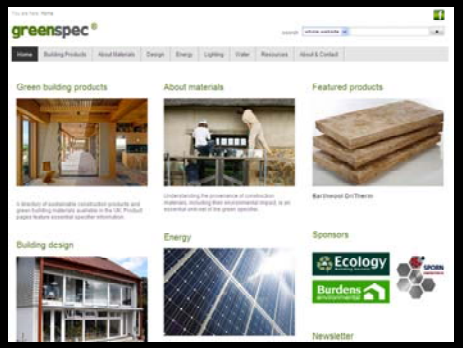
+5years
Part L & CfSH

+10
Kyoto Targets
-20% CO2
CfSH

+50
Energy White Paper
-60% CO2

Commercial Green

- Not 100% glazed and 100% A/C
  - Solar control essential
- Appropriate Technologies
  - Commercially Developed Technologies
- Appropriate design
  - Not: I can CAD, CAD can, So I do
  - 1000 x 1 or 1 x 1000
- Multi functional systems
  - Value Engineering Stuff into projects
- Resource Efficient Design
  - Avoiding Waste



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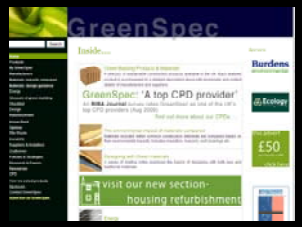
Embodied Energy Embodied Carbon & Carbon Footprints

Embodied Carbon Footprints

- Embodied Carbon
- Embodied Energy
- Materials Elements/Systems Buildings
- Carbon Footprint



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Jargon Buster: Carbon Dioxide CO_2

Definitions & Meanings

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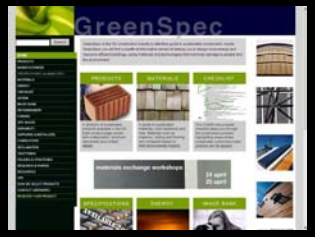

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Embodied Carbon

CPD topic

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Embodied Environmental impacts

- Not just Carbon
  - Resource Consumption
    - Energy
    - Materials
      - Chemicals
    - Water
  - Waste
  - Emissions
    - Pollution to air
    - Pollution to land: waste
    - Pollution to water
    - Pollution to humans, animals and plants

Embodied Carbon in Energy

UK Carbon Content of Fuel	kgCO2/kWh 2009 (Carbon Trust)
Grid Electricity	0.537
Coal	0.330
Oil (Gas oil)	0.252
LPG	0.214
Natural Gas	0.185
Biomass	0.025 If sourced with 30km of the site
Solar	0.000

Embodied Energy & Carbon in:

- Materials & Products
  - Labour to: quarry, forest, field, factory
  - Energy & Fuel in: factory, mill, quarry
  - Transport from quarry, forest, field to factory
- Packaging, Protection & Stability
- Logistics to site (inefficient is worse)
- Labour & Transport to site
  - Assembly on site
- Waste
  - Support, Packaging, Separation, Protection & Stability
  - Off-cuts
  - Over ordered
  - Stolen or disappeared
  - Damaged or spoiled
  - Rejected on quality grounds
- Labour & Transport to landfill

Embodied Energy & Carbon in:

- Materials
  - Mixing of resources and their assembly
- Products: assembly of materials
  - And the fixings, fasteners, adhesives
- Elements: assemblies of component parts
  - And the fixings, fastenings, adhesives
- Buildings: assemblies of elements
  - And the connecting of parts
  - And the sealing of joints between parts
- Finishing them off

Low Carbon Healthy high performance materials

- BRE GGtS is a barrier to low carbon materials
  - Alliance formed to break that barrier
  - Many participating companies
  - Many developing tools
    - GreenSpec is part of the offering
  - natureplus® products available across EU,
  - big move to bring the label to UK
- Launching in September

www.greenspec.co.uk

Violet materials: Cement Concrete & Blockwork

The Environment & The Problems
The Competition & Some Solutions

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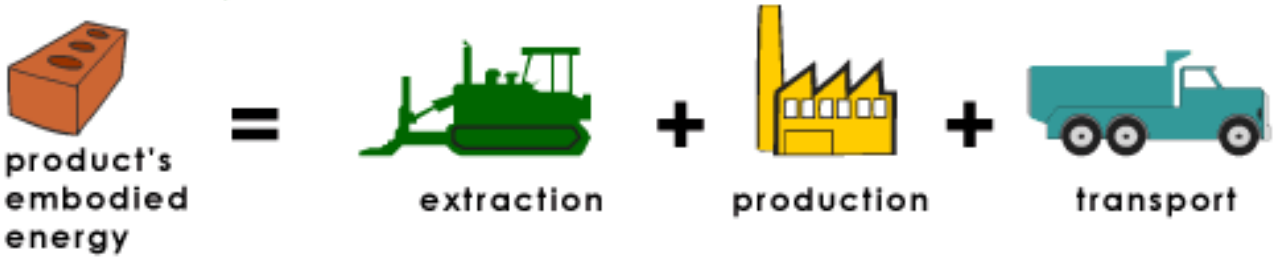
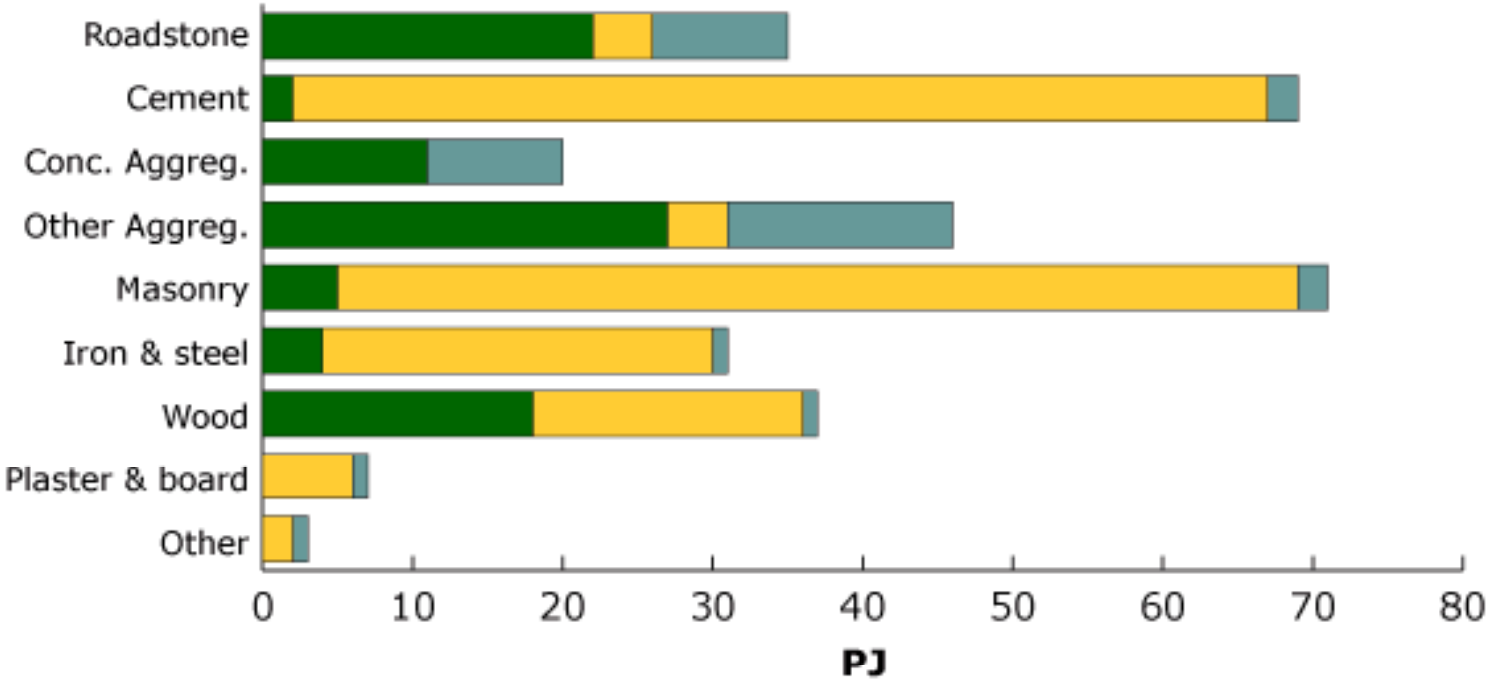
Energy in the UK

Energy used in the production of construction materials



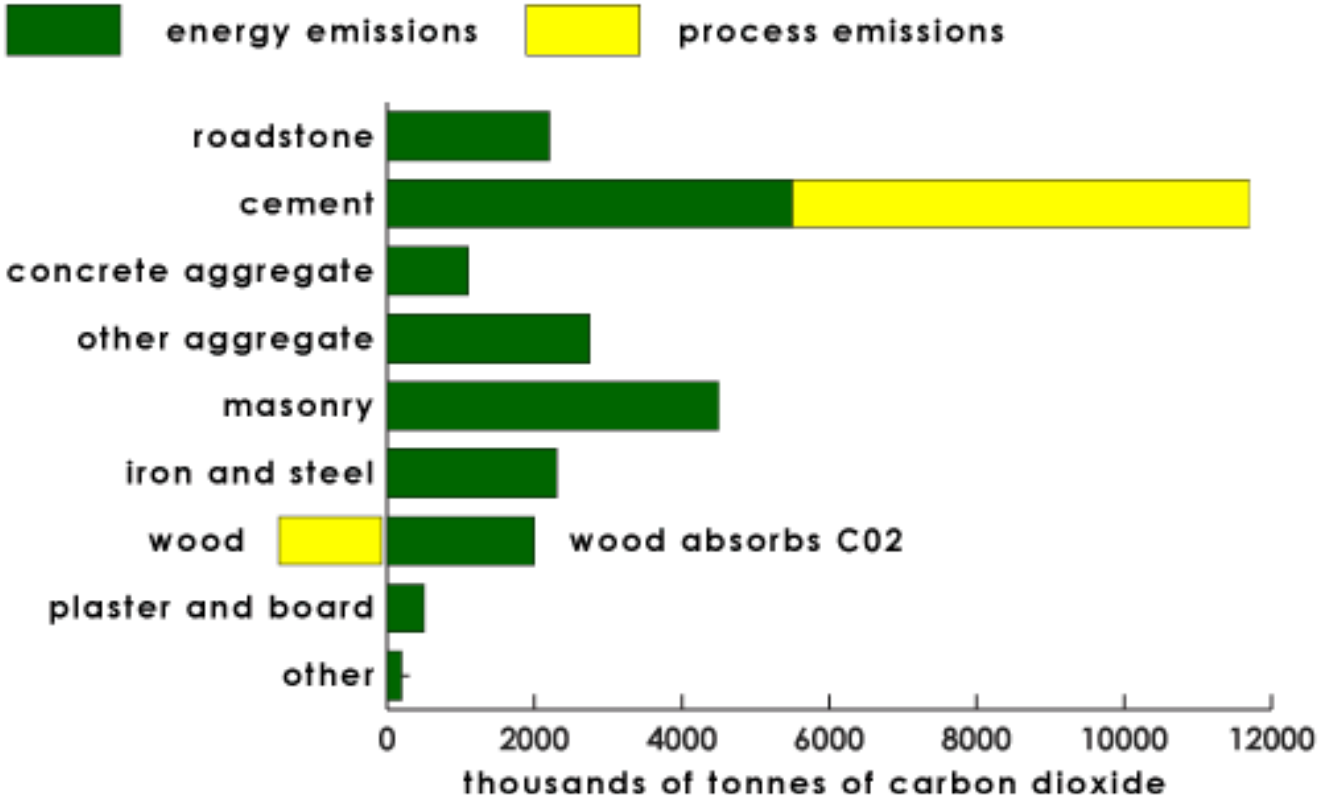


Where the energy comes from

currently 33% 41% 16% 9% 1%

CO_2 emissions from the production of construction materials

the construction industry emits 10% of UK CO_2



What are greenhouse gases?

Some greenhouse gases occur naturally in the atmosphere, while others result from human activities. Naturally occuring greenhouse gases include water vapour, carbon dioxide, methane, nitrous oxide and ozone. Certain human activities, however, add to the levels of most of these naturally occurring gases:

Carbon dioxide is released to the atmosphere when solid waste, fossil fuels (oil, natural gas and coal) and wood and wood products are burned. CO2 represents around 50% of all greenhouse gases.

Methane is emitted during the production and transport of coal, natural gas and oil. Methane emissions also result from the decomposition of organic wastes in municipal solid waste landfills, and the raising of livestock.

Nitrous oxide is emitted during agricultural and industrial activities, as well as during combustion of solid waste and fossil fuels.

Very powerful greenhouse gases that are not naturally occurring include **hydrofluorocarbons** (HFCs),

Embodied C & E in Resources

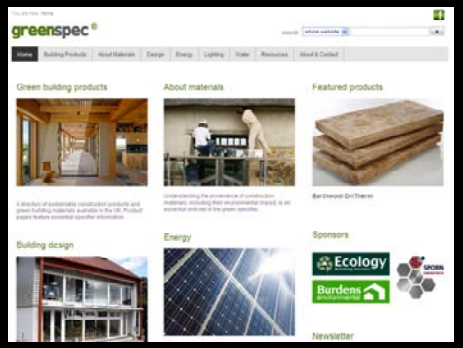
- Minerals: Low generally
- Rock:
  - Some is seasonal
  - Heavy to extract, handle, package, transport
  - Processing and finishing
- Sub Soil & Top Soil:
  - Heavy & bulky to transport
  - Cheap to dispose of subsoil
  - Topsoil is scarce reuse it
  - Use it on site,
  - Minimise export and import
- Shell:
  - Renewable
    - DPM, Render,

Embodied C & E in Resources

- Vegetable: Trees, Plants
- Applications:
  - Insulation, structure, framing, surfaces
- Trees
  - Renewable
  - Carbon Negative: Carbon Sequestration
  - After processing: (some energy inputs)
    - Negative, neutral or low
- Plants & Bamboo
  - Rapidly renewable
  - Carbon Negative: Carbon Sequestration
  - After processing: (some energy inputs)
    - Negative, neutral or low

Embodied C & E in Resources:

- Animal:
  - Skin, Fur, Feather, Milk, Shell, Residual, Waste
- Rapidly renewable:
  - Fur/Hair/Wool: seasonal; Insulation, reinforcement
  - Milk & Egg: Daily: Paints
  - Poo: plaster, bricks, fuel
- Renewable: at end of animals life
  - Leather, Linings, Rugs, Glue, Dye, Paint
  - Shell: DPM, renders
- Vegan: anti animal exploitation
  - Whilst we remain carnivores:
    - meat bi-products: not waste



ICE Database

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- Warts and all
  - Inconsistency reigns
  - But its all we have at the moment
- Materials
  - Good guide as to which materials to avoid
  - Use less of the worst
- Proportion
  - Need to calculate elements and buildings
  - But violet industry wants us to ignore the material characteristics
  - Use less of the worst

ABOUT MATERIALS

Materials: manufacture, use & impact

Materials: whole life costing

Materials

Contents

[Materials: their manufacture, use and and environmental impact]

An awareness of the impact of specifying materials is an essential part of the approach to green building design. This section looks at a large variety of traditional, contemporary and new materials and products. It examines their manufacture, their impact on the environment and human health, as well as providing guidance to their use.

[Materials: whole life performance and cost]

The longer the whole life performance and lower the whole life cost the better a component performs from a sustainability perspective. This section contains a series of articles written by Peter Mayer and first published in *Building* magazine.

greenspec®

ABOUT MATERIALS

Materials: manufacture, use & impact
Embodied energy
Recycled content
Reclaimed materials
The EU REACH regulation
Rammed earth
Cement substitutes
Reducing the impact of concrete
Bricks
Blocks
Unfired clay bricks
Unfired clay bricks and structure
Pitched roofs 1: Wood, slate & clay
Pitched roofs 2: Concrete & synthetic
Pitched roofs 3: Metals

Materials:
their manufacture, use & environmental impact

Materials generally

Embodied energy
As the amount of energy used in the running of a building (operational energy) shrinks, the energy used in its construction becomes more significant.

Recycled content
Thanks to the introduction of the ISO 14021 standard, it is now far easier for the specifier to determine the recycled content of building materials and products.

Reclaimed materials
Direct substitution of reclaimed materials for new can radically reduce the environmental impact of that particular item.

The REACH Regulation - and what it means
It can be argued that the recently introduced European REACH regulation will have a far-reaching influence on the constituents of common construction products.

E Concrete and earth

Rammed earth
A traditional form of construction is once again becoming popular owing to its very low embodied energy and ready availability.

Cement substitutes
With cement production regularly topping the emissions' tables, the need for using

ABOUT MATERIALS

Materials: manufacture, use & impact

- Embodied energy
- Recycled content
- Reclaimed materials
- The EU REACH regulation
- Rammed earth
- Cement substitutes
- Reducing the impact of concrete
- Bricks
- Blocks
- Unfired clay bricks
- Unfired clay bricks and structure
- Pitched roofs 1: Wood, slate & clay
- Pitched roofs 2: Concrete & synthetic
- Pitched roofs 3: Metals

Embodied energy

The embodied energy (carbon) of a building material can be taken as the total primary energy consumed (carbon released over its life cycle). This would normally include (at least) extraction, manufacturing and transportation. Ideally the boundaries would be set from the extraction of raw materials (including fuels) until the end of the products lifetime (including energy from manufacturing, transport, energy to manufacture capital equipment, heating and lighting of factory, maintenance, disposal etc.), known as 'Cradle-to-Grave'. It has become common practice to specify the embodied energy as 'Cradle-to-Gate', which includes all energy (in primary form) until the product leaves the factory gate. The final boundary condition is 'Cradle –to-Site', which includes all of the energy consumed until the product has reached the point of use (ie the building site).

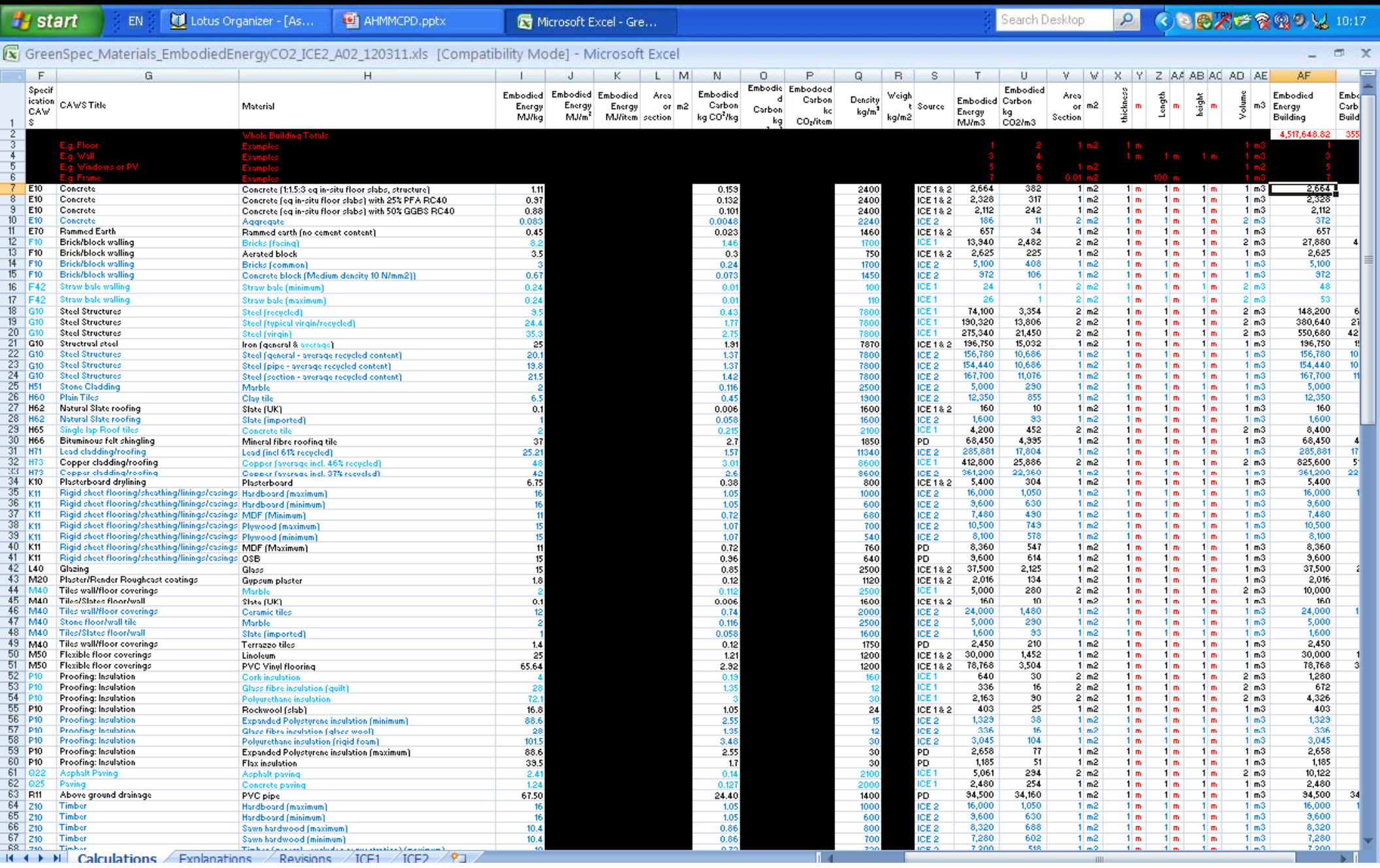
The figures included in the following table are a much-shortened and abbreviated adaptation of a survey published by the Sustainable Energy Research Team (SERT) of the University of Bath. The survey, 'Inventory of Carbon & Energy (ICE)' V1.6a, was compiled and written by Prof. Geoff Hammond & Craig Jones, 2008. The full detailed survey, complete with original data, methodology and notes, is available from www.bath.ac.uk/mech-eng/sert/embodied/

The figures are based on a 'Cradle-to-Gate' analysis of publicly available information.

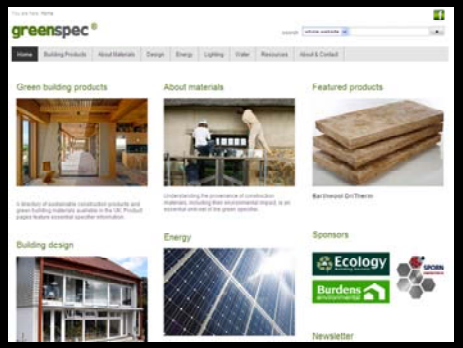
Material	Energy MJ/kg	Carbon kg CO^2/kg	Density kg /m^3
Aggregate	0.1	0.005	2240
Concrete (1:1.5:3 eg in-situ floor slabs, structure)	1.11	0.159	2400
Concrete (eg in-situ floor slabs) with 25% PFA RC40	0.97	0.132	
Concrete (eg in-situ floor slabs) with 50% GGBS RC40	0.88	0.101	
Bricks (facing)	8.2	0.52	1700

Material	Embodied Energy MJ/kg	Embodied Energy MJ/m^2	Embodied Energy MJ/item	Area m2	Embodied Carbon kg CO^2/kg	Embodied Carbon kg CO^2/m^2	Embodoed Carbon kc CO_2/item	Density kg/m^3
Aggregate	0.083				0.0048			2240
Concrete (1:1.5:3 eg in-situ floor slabs, structure)	1.11				0.159			2400
Concrete (eg in-situ floor slabs) with 25% PFA RC40	0.97				0.132			2400
Concrete (eg in-situ floor slabs) with 50% GGBS RC40	0.88				0.101			2400
Bricks (common)	3				0.24			1700
Concrete block (Medium density 10 N/mm2))	0.67				0.073			1450
Aerated block	3.5				0.3			750
Rammed earth (no cement content)	0.45				0.023			1460
Rammed earth (with cement content)								1460
Limestone block	0.85							2180
Marble	2				0.116			2500
Marble	2				0.116			2500
Cement mortar (1:3)	1.33				0.208			
Steel (general - average recycled content)	20.1				1.37			7800
Steel (section - average recycled content)	21.5				1.42			7800
Steel (pipe - average recycled content)	19.8				1.37			7800
Stainless steel	56.7				6.15			
Timber (general - excludes sequestration)	10				0.72			480
Timber (general - includes sequestration)	10							480
Timber (general - excludes sequestration)	10				0.72			720
Timber (general - includes sequestration)	10							720
Glue laminated timber	12				0.87			
Sawn hardwood	10.4				0.86			700
Sawn hardwood	10.4				0.86			800
Cellular glass insulation	27							
Cellulose insulation (loose fill)	0.94							43
Cellulose insulation (loose fill)	3.3							43
Cork insulation	26							160
Glass fibre insulation (glass wool)	28				1.35			12
Flax insulation	39.5				1.7			30
Rockwool (slab)	16.8				1.05			24
Expanded Polystyrene insulation	88.6				2.55			15
Expanded Polystyrene insulation	88.6				2.55			30
Polyurethane insulation (rigid foam)	101.5				3.48			30
Woodwool board insulation	20				0.98			
Wool (recycled) insulation	20.9							25
Straw bale	0.91							100
Straw bale	0.91							110
Mineral fibre roofing tile	37				2.7			1850
Slate (UK)	0.1				0.006			1600
Slate (imported)	1				0.058			1600
Slate (UK)	0.1				0.006			1600
Slate (imported)	1				0.058			1600
Clay tile	6.5				0.45			1900
Aluminium (general & incl 33% recycled)	155				8.24			2700
Bitumen (general) min.	51				0.38			
Bitumen (general) max.	51				0.43			
Hardboard	16				1.05			600
Hardboard	16				1.05			1000
Hardboard	16				1.05			600
Hardboard	16				1.05			1000
MDF	11				0.72			680
MDF	11				0.72			760
OSB	15				0.96			640
Plywood	15				1.07			540
Plywood	15				1.07			700
Plasterboard	6.75				0.38			800
Gypsum plaster	1.8				0.12			1120
Glass	15				0.85			2500
PVC (general)	77.2				28.1			1380
PVC pipe	67.50				24.40			1400
Linoleum	25				1.21			1200
PVC Vinyl flooring	65.64				2.92			1200
Terrazzo tiles	1.4				0.12			1750
Ceramic tiles	12				0.74			2000
Carpet tiles, nylon (Polyamide), pile weight 770g/m2		279				13.7		
Wool carpet	106				5.53			
Wallpaper	36.4				1.93			
Wood stain / varnish	50				5.35			
Vitrified clay pipe (DN 500)	7.9				0.52			

Building Calculations



	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA	AB	AC	AD	AE	AF	
1	Specification CAWS	CAWS Title	Material	Embodied Energy MJ/kg	Embodied Energy MJ/m²	Embodied Energy MJ/item	Area or section	m2	Embodied Carbon kg CO²/kg	Embodied Carbon kg	Embodoed Carbon kg CO₂/item	Density kg/m³	Weight kg/m2	Source	Embodied Energy MJ/m3	Embodied Carbon kg CO2/m3	Area or Section	m2	thickness	m	Length	m	height	m	Volume	m3	Embodied Energy Building	Embodied Carbon Building
2			Whole Building Totals																								4,517,648.82	355
3		E.g. Floor	Examples												1	2	1	m2	1	m					1	m3	1	
4		E.g. Wall	Examples												3	4			1	m	1	m	1	m	1	m3	3	
5		E.g. Windows or PV	Examples												5	6	1	m2							1	m2	5	
6		E.g. Frame	Examples												7	8	0.01	m2			100	m			1	m3	7	
7	E10	Concrete	Concrete (1:1.5:3 eq in-situ floor slabs, structure)	1.11					0.159			2400		ICE 1 & 2	2,664	382	1	m2	1	m	1	m	1	m	1	m3	2,664	
8	E10	Concrete	Concrete (eq in-situ floor slabs) with 25% PFA RC40	0.97					0.132			2400		ICE 1 & 2	2,328	317	1	m2	1	m	1	m	1	m	1	m3	2,328	
9	E10	Concrete	Concrete (eq in-situ floor slabs) with 50% GGBS RC40	0.88					0.101			2400		ICE 1 & 2	2,112	242	1	m2	1	m	1	m	1	m	1	m3	2,112	
10	E10	Concrete	Aggregate	0.083					0.0048			2240		ICE 2	186	11	2	m2	1	m	1	m	1	m	2	m3	372	
11	E70	Rammed Earth	Rammed earth (no cement content)	0.45					0.023			1460		ICE 1 & 2	657	34	1	m2	1	m	1	m	1	m	1	m3	657	
12	F10	Brick/block walling	Bricks (facing)	6.2					1.46			1700		ICE 1	13,340	2,482	2	m2	1	m	1	m	1	m	2	m3	27,880	4
13	F10	Brick/block walling	Aerated block	3.5					0.3			750		ICE 1 & 2	2,625	225	1	m2	1	m	1	m	1	m	1	m3	2,625	
14	F10	Brick/block walling	Bricks (common)	3					0.24			1700		ICE 2	5,100	408	1	m2	1	m	1	m	1	m	1	m3	5,100	
15	F10	Brick/block walling	Concrete block (Medium density 10 N/mm2))	0.67					0.073			1450		ICE 2	972	106	1	m2	1	m	1	m	1	m	1	m3	372	
16	F42	Straw bale walling	Straw bale (minimum)	0.24					0.01			100		ICE 1	24	1	2	m2	1	m	1	m	1	m	2	m3	48	
17	F42	Straw bale walling	Straw bale (maximum)	0.24					0.01			110		ICE 1	26	1	2	m2	1	m	1	m	1	m	2	m3	53	
18	G10	Steel Structures	Steel (recycled)	9.5					0.43			7800		ICE 1	74,100	3,354	2	m2	1	m	1	m	1	m	2	m3	148,200	6
19	G10	Steel Structures	Steel (typical virgin/recycled)	24.4					1.77			7800		ICE 1	190,320	13,806	2	m2	1	m	1	m	1	m	2	m3	380,640	21
20	G10	Steel Structures	Steel (virgin)	35.3					2.75			7800		ICE 1	275,340	21,450	2	m2	1	m	1	m	1	m	2	m3	550,680	42
21	G10	Structrual steel	Iron (general & average)	25					1.91			7870		ICE 1 & 2	196,750	15,032	1	m2	1	m	1	m	1	m	1	m3	196,750	15
22	G10	Steel Structures	Steel (general - average recycled content)	20.1					1.37			7800		ICE 2	156,780	10,686	1	m2	1	m	1	m	1	m	1	m3	156,780	10
23	G10	Steel Structures	Steel (pipe - average recycled content)	19.8					1.37			7800		ICE 2	154,440	10,686	1	m2	1	m	1	m	1	m	1	m3	154,440	10
24	G10	Steel Structures	Steel (section - average recycled content)	21.5					1.42			7800		ICE 2	167,700	11,076	1	m2	1	m	1	m	1	m	1	m3	167,700	11
25	H51	Stone Cladding	Marble	2					0.116			2500		ICE 2	5,000	290	1	m2	1	m	1	m	1	m	1	m3	5,000	
26	H60	Plain Tiles	Clay tile	6.5					0.45			1300		ICE 2	12,350	855	1	m2	1	m	1	m	1	m	1	m3	12,350	
27	H62	Natural Slate roofing	Slate (UK)	0.1					0.006			1600		ICE 1 & 2	160	10	1	m2	1	m	1	m	1	m	1	m3	160	
28	H62	Natural Slate roofing	Slate (imported)	1					0.058			1600		ICE 2	1,600	93	1	m2	1	m	1	m	1	m	1	m3	1,600	
29	H65	Single lap Roof tiles	Concrete tile	2					0.215			2100		ICE 1	4,200	452	2	m2	1	m	1	m	1	m	2	m3	8,400	
30	H66	Bituminous felt shingling	Mineral fibre roofing tile	37					2.7			1850		PD	68,450	4,995	1	m2	1	m	1	m	1	m	1	m3	68,450	4
31	H71	Lead cladding/roofing	Lead (incl 61% recycled)	25.21					1.57			11340		ICE 2	285,881	17,804	1	m2	1	m	1	m	1	m	1	m3	285,881	17
32	H73	Copper cladding/roofing	Copper (average incl. 46% recycled)	48					3.01			8600		ICE 1	412,800	25,886	2	m2	1	m	1	m	1	m	2	m3	825,600	51
33	H73	Copper cladding/roofing	Copper (average incl. 37% recycled)	42					2.6			8600		ICE 2	361,200	22,360	1	m2	1	m	1	m	1	m	1	m3	361,200	22
34	K10	Plasterboard drylining	Plasterboard	6.75					0.38			800		ICE 1 & 2	5,400	304	1	m2	1	m	1	m	1	m	1	m3	5,400	
35	K11	Rigid sheet flooring/sheathing/linings/casings	Hardboard (maximum)	16					1.05			1000		ICE 2	16,000	1,050	1	m2	1	m	1	m	1	m	1	m3	16,000	1
36	K11	Rigid sheet flooring/sheathing/linings/casings	Hardboard (minimum)	16					1.05			600		ICE 2	9,600	630	1	m2	1	m	1	m	1	m	1	m3	9,600	
37	K11	Rigid sheet flooring/sheathing/linings/casings	MDF (Minimum)	11					0.72			680		ICE 2	7,480	490	1	m2	1	m	1	m	1	m	1	m3	7,480	
38	K11	Rigid sheet flooring/sheathing/linings/casings	Plywood (maximum)	15					1.07			700		ICE 2	10,500	749	1	m2	1	m	1	m	1	m	1	m3	10,500	
39	K11	Rigid sheet flooring/sheathing/linings/casings	Plywood (minimum)	15					1.07			540		ICE 2	8,100	578	1	m2	1	m	1	m	1	m	1	m3	8,100	
40	K11	Rigid sheet flooring/sheathing/linings/casings	MDF (Maximum)	11					0.72			760		PD	8,360	547	1	m2	1	m	1	m	1	m	1	m3	8,360	
41	K11	Rigid sheet flooring/sheathing/linings/casings	OSB	15					0.96			640		PD	9,600	614	1	m2	1	m	1	m	1	m	1	m3	9,600	
42	L40	Glazing	Glass	15					0.85			2500		ICE 1 & 2	37,500	2,125	1	m2	1	m	1	m	1	m	1	m3	37,500	2
43	M20	Plaster/Render Roughcast coatings	Gypsum plaster	1.8					0.12			1120		ICE 1 & 2	2,016	134	1	m2	1	m	1	m	1	m	1	m3	2,016	
44	M40	Tiles wall/floor coverings	Marble	2					0.112			2500		ICE 1	5,000	280	2	m2	1	m	1	m	1	m	2	m3	10,000	
45	M40	Tiles/Slates floor/wall	Slate (UK)	0.1					0.006			1600		ICE 1 & 2	160	10	1	m2	1	m	1	m	1	m	1	m3	160	
46	M40	Tiles wall/floor coverings	Ceramic tiles	12					0.74			2000		ICE 2	24,000	1,480	1	m2	1	m	1	m	1	m	1	m3	24,000	1
47	M40	Stone floor/wall tile	Marble	2					0.116			2500		ICE 2	5,000	290	1	m2	1	m	1	m	1	m	1	m3	5,000	
48	M40	Tiles/Slates floor/wall	Slate (imported)	1					0.058			1600		ICE 2	1,600	93	1	m2	1	m	1	m	1	m	1	m3	1,600	
49	M40	Tiles wall/floor coverings	Terrazzo tiles	1.4					0.12			1750		PD	2,450	210	1	m2	1	m	1	m	1	m	1	m3	2,450	
50	M50	Flexible floor coverings	Linoleum	25					1.21			1200		ICE 1 & 2	30,000	1,452	1	m2	1	m	1	m	1	m	1	m3	30,000	1
51	M50	Flexible floor coverings	PVC Vinyl flooring	65.64					2.32			1200		ICE 1 & 2	78,768	3,504	1	m2	1	m	1	m	1	m	1	m3	78,768	3
52	P10	Proofing: Insulation	Cork insulation	4					0.19			160		ICE 1	640	30	2	m2	1	m	1	m	1	m	2	m3	1,280	
53	P10	Proofing: Insulation	Glass fibre insulation (quilt)	28					1.35			12		ICE 1	336	16	2	m2	1	m	1	m	1	m	2	m3	672	
54	P10	Proofing: Insulation	Polyurethane insulation	72.1					3			30		ICE 1	2,163	90	2	m2	1	m	1	m	1	m	2	m3	4,326	
55	P10	Proofing: Insulation	Rockwool (slab)	16.8					1.05			24		ICE 1 & 2	403	25	1	m2	1	m	1	m	1	m	1	m3	403	
56	P10	Proofing: Insulation	Expanded Polystyrene insulation (minimum)	88.6					2.55			15		ICE 2	1,329	38	1	m2	1	m	1	m	1	m	1	m3	1,329	
57	P10	Proofing: Insulation	Glass fibre insulation (glass wool)	28					1.35			12		ICE 2	336	16	1	m2	1	m	1	m	1	m	1	m3	336	
58	P10	Proofing: Insulation	Polyurethane insulation (rigid foam)	101.5					3.48			30		ICE 2	3,045	104	1	m2	1	m	1	m	1	m	1	m3	3,045	
59	P10	Proofing: Insulation	Expanded Polystyrene insulation (maximum)	88.6					2.55			30		PD	2,658	77	1	m2	1	m	1	m	1	m	1	m3	2,658	
60	P10	Proofing: Insulation	Flax insulation	39.5					1.7			30		PD	1,185	51	1	m2	1	m	1	m	1	m	1	m3	1,185	
61	Q22	Asphalt Paving	Asphalt paving	2.41					0.14			2100		ICE 1	5,061	294	2	m2	1	m	1	m	1	m	2	m3	10,122	
62	Q25	Paving	Concrete paving	1.24					0.127			2000		ICE 1	2,480	254	1	m2	1	m	1	m	1	m	1	m3	2,480	
63	R11	Above ground drainage	PVC pipe	67.50					24.40			1400		PD	94,500	34,160	1	m2	1	m	1	m	1	m	1	m3	94,500	34
64	Z10	Timber	Hardboard (maximum)	16					1.05			1000		ICE 2	16,000	1,050	1	m2	1	m	1	m	1	m	1	m3	16,000	1
65	Z10	Timber	Hardboard (minimum)	16					1.05			600		ICE 2	9,600	630	1	m2	1	m	1	m	1	m	1	m3	9,600	
66	Z10	Timber	Sawn hardwood (maximum)	10.4					0.86			800		ICE 2	8,320	688	1	m2	1	m	1	m	1	m	1	m3	8,320	
67	Z10	Timber	Sawn hardwood (minimum)	10.4					0.86			700		ICE 2	7,280	602	1	m2	1	m	1	m	1	m	1	m3	7,280	
68	Z10	Timber	Timber (general - excluding average plantation) (maximum)	10					0.72			720		ICE 2	7,200	518	1	m2	1	m	1	m	1	m	1	m3	7,200	



Spreadsheets

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- Posted on Scribd
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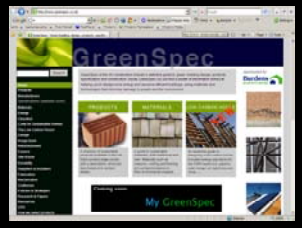
0.1	0.1	0.1	0.1				Whole Building Totals					
0	0.0	0.0	0.2			E.g. Floor	Examples					
0	0.0	0.0	0.3			E.g. Wall	Examples					
0	0.0	0.0	0.4			E.g. Windows or PV	Examples					
0	0.0	0.0	0.5			E.g. Frame	Examples					
102	1	2	1	Materials	E10	Concrete	Aggregate	0.083				
7	1	1	1	Materials	F10		Bricks (facing)	8.2				
106	1	2	1	Materials	F10	Brick/block walling	Bricks (common)	3				
107	1	2	1	Materials	F10	Brick/block walling	Concrete block (Medium density 10 N/mm2))	0.67				
11	1	1	1	Materials	F42	Straw bale walling	Straw bale (minimum)	0.24				
11	1	1	1	Materials	F42	Straw bale walling	Straw bale (maximum)	0.24				
12	1	1	1	Materials	G10		Steel (recycled)	9.5				
13	1	1	1	Materials	G10		Steel (typical virgin/recycled)	24.4				
14	1	1	1	Materials	G10		Steel (virgin)	35.3				
			1				average					
115	1	2	1	Materials	G10	Steel Structures	Steel (general - average recycled content)	20.1				
117	1	2	1	Materials	G10	Steel Structures	Steel (pipe - average recycled content)	19.8				
116	1	2	1	Materials	G10	Steel Structures	Steel (section - average recycled content)	21.5				
113	1	2	1	Materials	H51	Stone Cladding	Marble	2				
145	1	2	1	Materials	H60	Plain Tiles	Clay tile	6.5				
			1									
142	1	2	1	Materials	H62	Natural Slate roofing	Slate (imported)	1				
16	1	1	1	Materials		Single lap Roof tiles	Concrete tile	2				
			1									
174	1	2	1	Materials	H71	Lead cladding/roofing	Lead (incl 61% recycled)	25.21				
21	1	1	1	Materials	H73		Copper (average incl. 46% recycled)	48				
173	1	2	1	Materials	H73	Copper cladding/roofing	Copper (average incl. 37% recycled)	42				
			1									
152	1	2	1	Materials	K11	Rigid sheet flooring/sheathing/linings/casings	Hardboard (maximum)	16				
151	1	2	1	Materials	K11	Rigid sheet flooring/sheathing/linings/casings	Hardboard (minimum)	16				
153	1	2	1	Materials	K11	Rigid sheet flooring/sheathing/linings/casings	MDF (Minimum)	11				
157	1	2	1	Materials	K11	Rigid sheet flooring/sheathing/linings/casings	Plywood (maximum)	15				
156	1	2	1	Materials	K11	Rigid sheet flooring/sheathing/linings/casings	Plywood (minimum)	15				
			1			Rigid sheet flooring/sheathing/linings/casings						
			1			Rigid sheet flooring/sheathing/linings/casings						
			1									
			1									
39	1	1	1	Materials	M40		Marble	2				
			1									
166	1	2	1	Materials	M40	Tiles wall/floor coverings	Ceramic tiles	12				
112	1	2	1	Materials	M40	Stone floor/wall tile	Marble	2				
144	1	2	1	Materials	M40	Tiles/Slates floor/wall	Slate (imported)	1				
			1									
			1									
			1									

LCA Life Cycle Assessment

- Using SimaPro and EcoInvent
- Sizes and section areas and density
- Calculate the Environmental Impacts
- In near future LCA & EPD will become available to consider
- Some time soon BIM + LCA
- 3D CAD Generated LCA of building



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Embodied Energy + CO2; EP v IUP

Embodied Energy, Embodied CO2,

Environmental Profiles V In Use Performance

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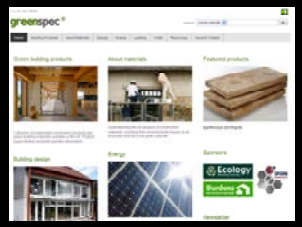

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Embodied V In Use Energy

CPD topic

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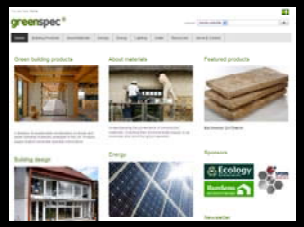

COMMENDED
The UK eWell-Being Awards 2004
www.sustainit.org

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LCGB: Low Carbon Green Buildings

Brian Murphy (GreenSpec)

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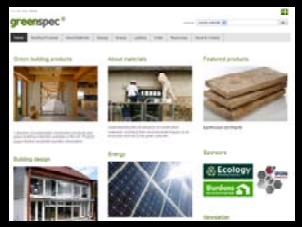
Carbon reduction in design

- Visit the site
- Determine what existing buildings can provide
  - Buildings, materials, recyclate
- Determine what nature can provide
  - Solar access
  - Prevailing wind
  - Ground water and its movement
  - Geothermal heat and storage capacity
  - Precipitation and surface water

Carbon reduction in design

- Dematerialise
  - No suspended ceilings
  - No raised access floors? Cant do both?
- Expose thermal mass
  - Exploit thermal mass
  - Fair faced construction
  - Precious about quality? if you can get it
  - Less precious about quality? If you cant



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BRE Green Guide
&
GreenSpecStudio

On-line design & Specification tool

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Choosing Materials

- You can consider 13 negatives
  - BRE Green Guide to Specification
    - 1600 Ready made assemblies
  - Environmental Profiling
    - Green Book Live
  - And choose the least violet of the violets
- Or you can consider 276 positives
  - GreenSpec selection criteria
    - GreenSpec Product Pages
    - And choose the greenest of the greens
  - GreenSpec Studio: 892 Assemblies

Carbon reduction in materials:

- High low neutral or negative carbon
- Simple manufacture
- Low carbon fuels
- Less energy
- Chemical and Petrochemical avoidance
- Less bonding more assembly

Energy reduction in manufacture:

- Nickel sulfide inclusions
  - Heat soaking at high temperature for long periods
  - Compare with replacing broken panes
  - Need an LCA to compare
- Aluminium
  - High embodied energy
  - Recycled aluminium 5% 1/20th energy of Virgin
  - Renewable energy is best
  - Hydro electric: high environmental impact

Carbon reduction in construction:

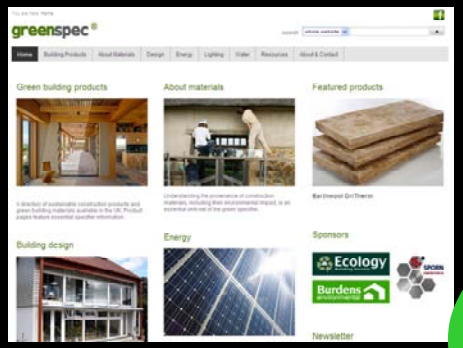
- Avoiding, reducing or replacing cement
  - GGBS to permitted %
  - Slower set, same ultimate strength
  - Impact on programme and construction methods and work sequence
- Water has a carbon load
  - Avoid wet processes
  - Dry construction methods
  - Drying evaporation uses heat energy

Carbon reduction in commissioning:

- Drying out building
  - Natural ventilation, if practical
- Testing M&E inevitably uses energy
- IR Thermography uses heat
- Airtightness testing uses electricity and drives out heat or sucks in coolth
- Co-ordinate the testing to use each other's energy if you can

Carbon reduction in use:

- Energy Efficiency:
  - Heat, Cool, Vent and Water
  - Natural rather than mechanical and fuel
- Economic to maintain:
  - Tough, Durable, Long life
  - Low cost cleaning
  - Keep good appearance
    - Long replacement interval



Embodied Water (the next big issue)

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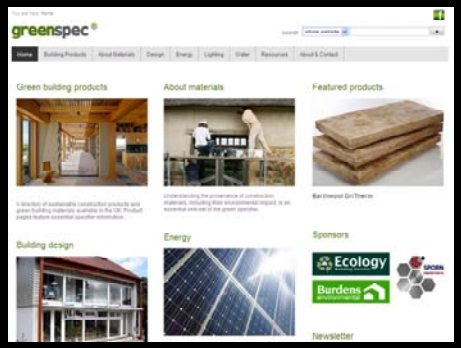
- Water used to create a material
  - In the process or the end products or both
  - Source
    - Mains, ground extraction, water bodies
      - Embodied Carbon in water
        - » Carbon load of water
    - Harvested, collected, used, recycled
  - No longer available to the population
    - Water stressed areas: reinforces problem
- Water polluted in the process
- Water in the product
  - Removed from the country of origin



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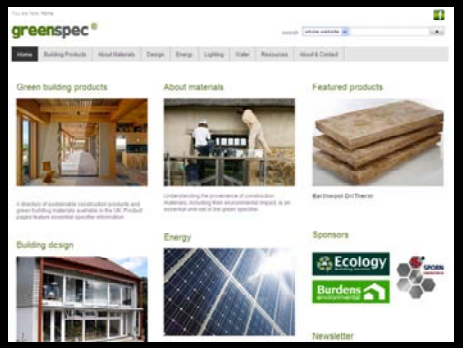
Greening Up NBS

Greening-Up NBS

- Don’t be limited by NBS format & content
- Require something don’t permit it
- Don’t permit what you do not want
- Specify why you wanted it
- Tender evaluation not just price
- Require evidence of equivalency
- Proactive Substitution Management clauses

Don’t be limited by NBS format & content

- Its competent and offers choice
  - But does not try to encourage being green
- Its started to green itself up
  - Mostly in the guidance
  - Insufficient: step changes needed
- Don’t be scared of enhancing an NBS clause
- Its only a checklist after all
- Does your PII provider discourage that?



Or Equivalent

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- Required in government funded projects
- In the NBS Preliminaries is enough
- But Wren insist its in the clauses too
- So you have to be more proactive:
  - in writing robust specification clauses
  - and policing the non-equivalents.

Require something don't permit it

- Many engineer's specifications permit greener choices by contractor
- But construction limits material choices
- Educate yourself in the greener option
- Design the greener option
- Specify the greener option
- Insist its is not substituted

Don’t permit something you do not want

- Specify what you want
  - If you want Composite timber/aluminium
  - Specify it
- Exclude what you do not want
  - If there is a risk of PVC substitution
  - And you do not want PVC
  - then exclude PVC

Specify why you wanted it

- If you chose a material or a products because of a property or attribute
- Specify that property or attribute in the document
- Use the specification as the project bible
- Use it to resist substitution
- Or your building will be deficient on the design

Tender Evaluation not just price

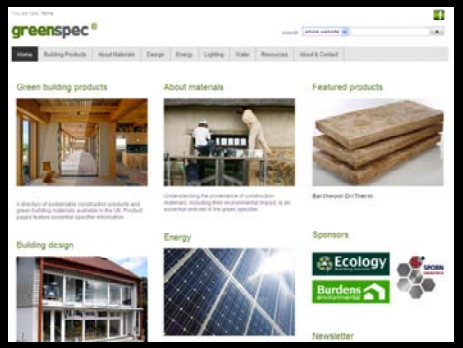
- Make reviewing the tender submission part of your responsibility
- Review their:
  - methods statement,
  - specification,
  - alternative and options,
  - substitutions
- Compare it with the specification

Require evidence of equivalency

- Make the Tenderers and the contractor responsible for proving their material choices or design
- In every respect that is specified
- They mark up literature against specification
- They compare and then bring a competent equivalent proposal

Proactive Substitution Management clauses

- Include a clause that requires round table meeting post-tender pre-contract to discuss all departures now
- All substitution proposals:
  - 1 month before ordering materials is required,
  - automatic rejection if too late
- They prove equivalency and you review
- They provide all alternative details
- They take responsibility for all substitutions
- List the criteria and your evidence sources by which evidence will be judged



Specifications

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- Posted on Scribd
- www.scribd.com/brianspecman

Specification Substitution

Case Law, practices & pitfalls

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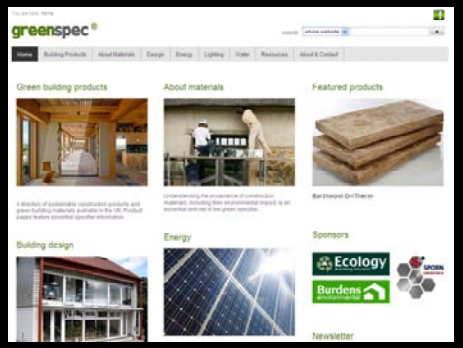

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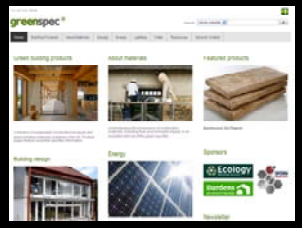
Anti Value Engineering measures



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Value Engineering

Posh for 'Cost Cutting'

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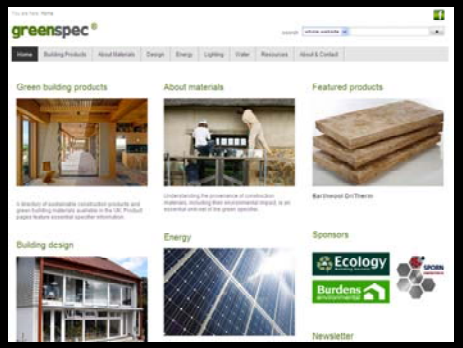

Raise our game

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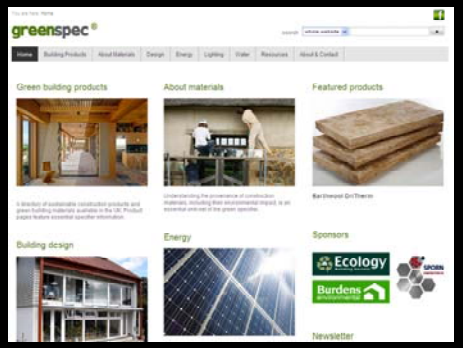
- QSs regularly use cost cutting dressed up as "Value Engineering" to cut stuff out of projects
- Architects need to learn how to Value Engineer stuff into projects



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Principles

- Value Engineering v Cost Cutting
- CC Same picture
  - Replace with 1 thing with a cheaper one
- VE Bigger picture
  - Replace 2 or 3 things with 1
  - Make 1 thing do 2 or 3 things
- Beware of ramifications
  - 1's reliance upon 2 to be avoided
  - Changing 1 requires a change in 2

Anti Value Engineering measures

- Green brief
  - Green feasibility study
  - WLC Whole Life Costing: Data
  - Carbon-back periods
- Green cost plan > Green pricing
  - No violet prices for comparison
  - No pay back periods
- Resource efficient design
- Green tenderers
  - Green contractors & applicators
- Green prices within green cost plan

Anti Value Engineering Measures

- VE stuff into projects
- VE stuff out of projects
  - Labour
  - Waste
  - Weather
  - Air

Labour is expensive

- Reduce labour
- Use multifunctional materials
- Use multifunctional components
  - More expensive to buy
  - Cheaper to install one than many
- Offsite prefabrication
- Off site preassembly
  - Less labour to travel go to site

Waste is expensive

- Reduce waste
  - Cutting: costs labour & costs materials
- Design to avoid cutting
  - Stop short and change materials
- Use products in the size they are made
  - Know the sizes and work with them
- Secondary elements sizes
  - to fit primary element sizes
- Work with modules not against them

Design to Reduce Waste

Condensed GreenSpec Display

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Reduce wasteful expensive

- Gypsum is Stable Non-Reactive Hazardous Waste (SNRHW)
- Finally DEFRA and EA are treating as required: = to asbestos
- Expensive disposal at SNRHW sites
- 30% wastage factors is normal
  - Recent BRE CRWP studies
- Don't use it
  - or use it efficiently and effectively

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Resource Efficiency

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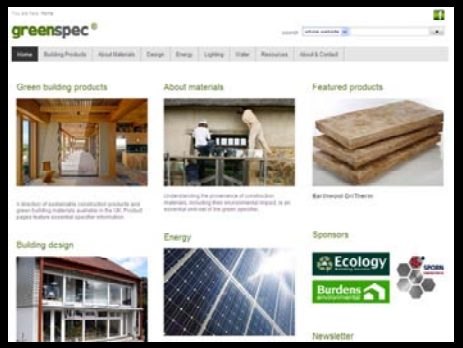
Weather is expensive

- Reduce weather influenced activity
  - Precipitation
    - Bad working conditions: poor workmanship
    - Low productivity
    - Traction in mud,
    - Splashes spoil materials
  - Cold
    - Prevents frost vulnerable trades
  - Wind
    - Materials handling & Stability
      - Frames/Modules/panels/pod
    - Worker safety
      - Falls, flames, fumes, dust

Air is Expensive

- Prefabricated off site,
  - Modules & Pods
  - Contain fresh air
  - Transporting fresh air is expensive
- Panelisation at factory
  - Flat pack delivery is economic no air
  - Assembly on site
- Leaky joints: air, heat & money escapes
  - Joints need to be designed thoroughly



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Anti D&B Substitution measures

Anti D&B Substitution measures

- Robust Briefing & Some Determination
- Competent Specification for Design
- Robust Specification
- No Lazy anything
- Proactive Substitution Management
- Competent building
- Policing the process

Robust Briefing & Some Determination

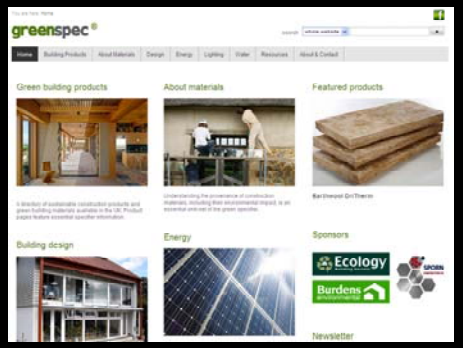
- No excess to requirements
  - Where compromise becomes easy
- No compromises
- Consider:
  - the pros and cons,
  - the gains and the losses,
  - not just lower price,
    - its budgeted for, why change?

Competent Specification for Design

- Performance Specification:
  - very thorough
  - With test and inspection clauses
- Climate compatible
  - Now and 60 years time
- Airtight Design
  - Airtightness line designed and shown
- Thermal Bridge Free
  - Thermal Flanking Free

Robust Specification

- Say what you want and mean it
- some slack?
  - If so where?
  - Decide in advance,
  - Say in advance in the Spec
- Proactive Substitution Management



No lazy anything

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- No lazy
  - Specification
  - Architecture
  - Engineering
  - Construction detailing
- Lazy?:
  - Business as Usual: Status Quo prevails
  - without challenging standard decisions
  - Set out at centre and cut round the edges
  - 100% glazed façade: happy Letting agent
  - Put three cold bridges in rather than structurally design them out

Proactive Substitution Management

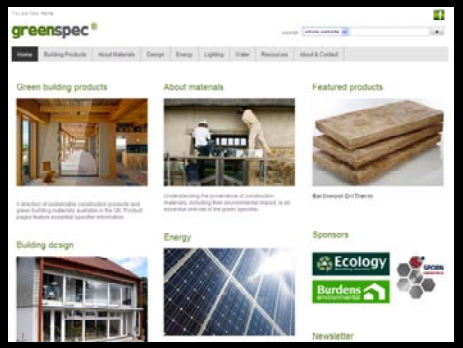
- If you specified
- Check its still there
- Police it on site
  - Beginning to end
  - Not just first delivery

Competent Building

- Meet the brief: not just Architecture
- Comply with regulation
  - Prove by testing & monitoring,
- Complying with specification
  - Prove by testing
- Buildability checked design
  - Resource Efficient:
    - Waste free
- Compatible materials
  - Especially if substitutions occur

Policing the process

- Educate the CA & Site Team
- Don't let them make wrong decisions
- Ensure they understand stuff that's in the spec.
- Make its possible to know in your absence
- Provide guidance notes in the supporting documents or specification system (NBS Building User notes)
- If in doubt ask



NBS Building

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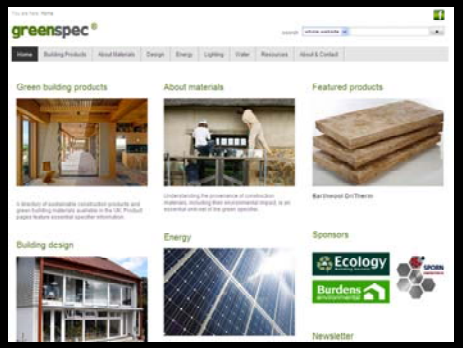
- Is a great source of information
- Is potentially a great place to embed Corporate Knowledge
- But this is not supported in major upgrades
- Once the NBS Next Generation is launched start using it in this way



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