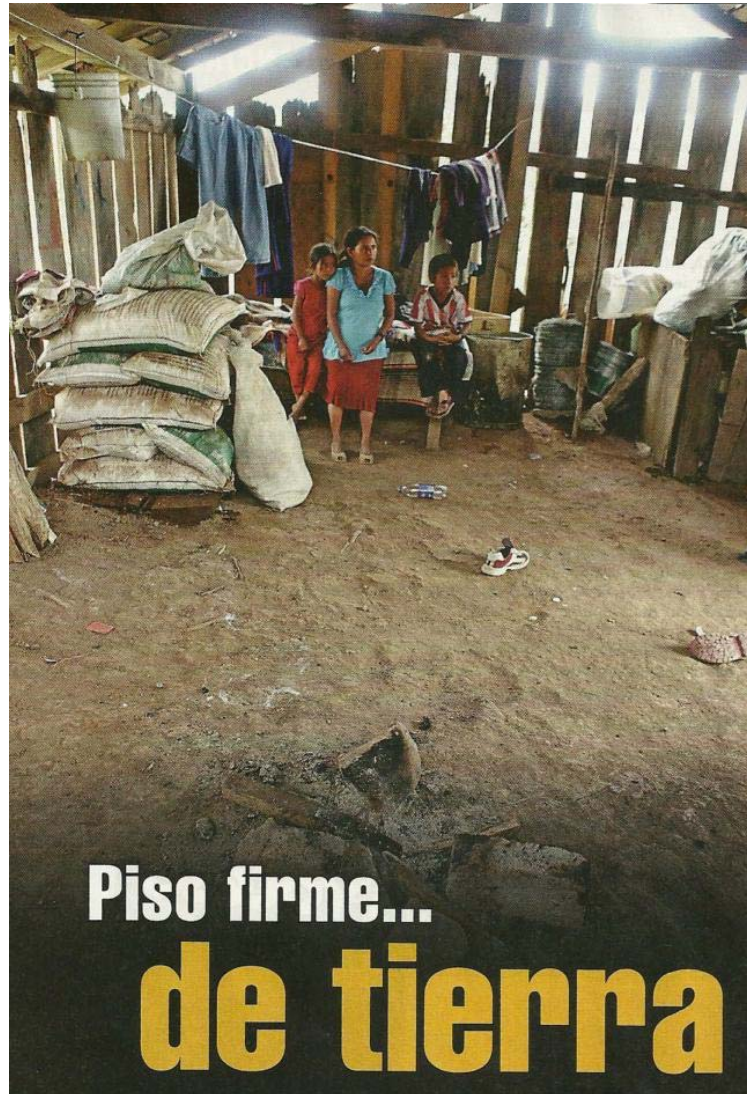


Sustainable concrete

Chris A Clear BSc PhD CEng MICE FICT FIMMM
Technical Director BRMCA



Concrete is
sustainable -
it would be impossible
to have sustainable
development without
concrete



Concrete is sustainable...

Homes



Health

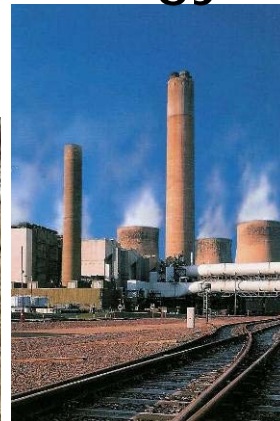
Sea
defence



Water



Energy



Business



Transport



Sustainable options

Hard engineering

Coastal railway,
Dawlish UK



Soft engineering

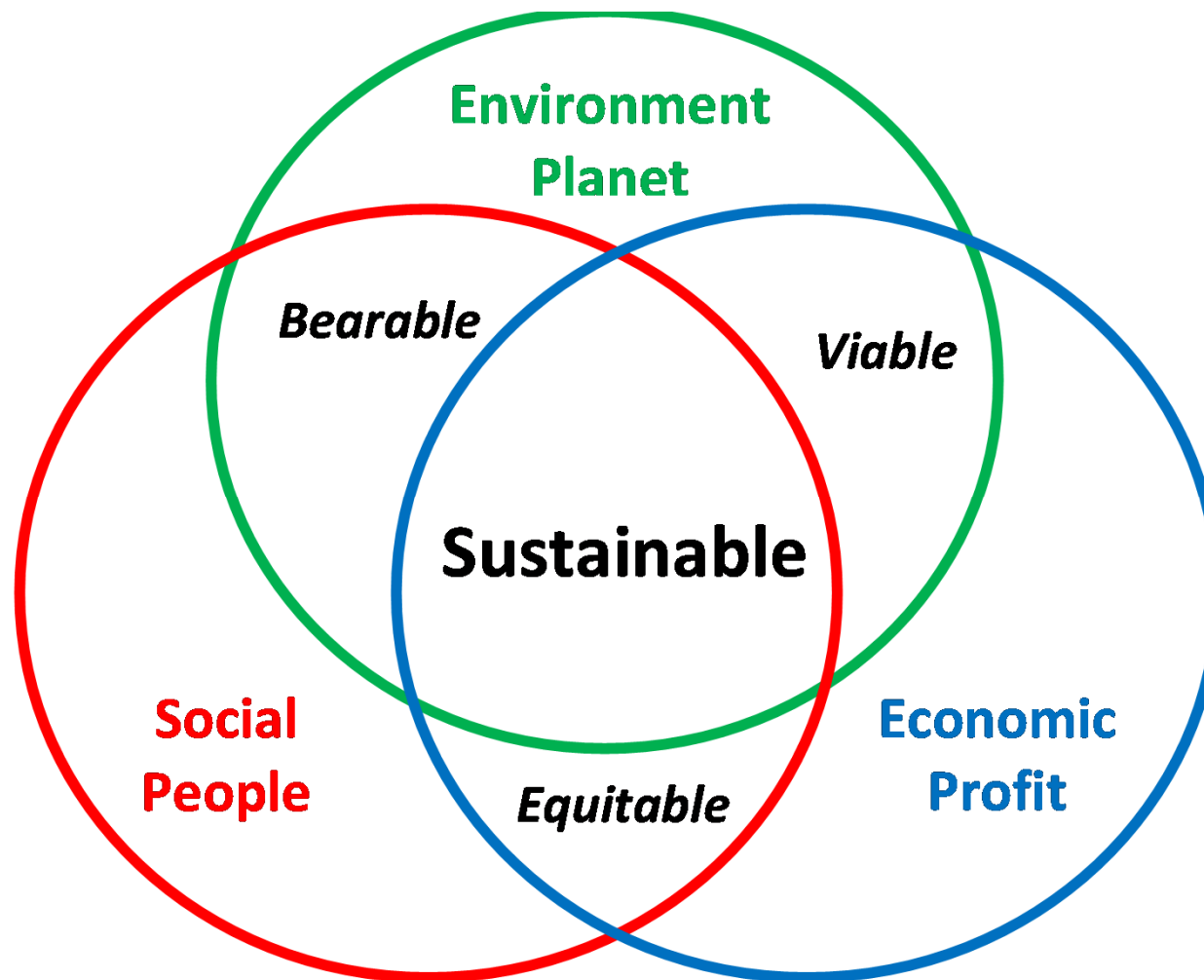
Flood alleviation scheme,
Maidenhead UK



Concrete is sustainable – but we need to supply evidence



Sustainability



Georgia
Guidestones
1980

Sustainable Construction

EN 15643 Sustainability of construction works - Assessment of buildings -

Part 1: General Framework

Part 2: Framework for the assessment of environment performance

Part 3: Framework for the assessment of social performance

Part 4: Framework for the assessment of economic performance

The scope of the sustainability of construction works is being expanded to cover the assessment of civil engineering works

EN 15643-4 Economic indicators

Cost	Financial value
— economic performance expressed in cost terms over the life-cycle	— economic performance expressed in terms of financial value over the life-cycle

Cost and value



EN 15643-3 Categories for social aspects

Health and comfort	Accessibility	Maintenance	Safety/ security	Loadings on the neighbourhood
<ul style="list-style-type: none"> — Thermal performance — Humidity — Quality of water for use in buildings — Indoor air quality — Acoustic performance — Visual comfort 	<ul style="list-style-type: none"> — Accessibility for people with specific needs 	<ul style="list-style-type: none"> — Maintenance requirement 	<ul style="list-style-type: none"> — Resistance to climate change — Fire safety — Security against intruders and vandalism — Security against interruptions of utility supply 	<ul style="list-style-type: none"> — Noise — Emissions — Glare — Shock/ vibrations

Thermal performance, maintenance, flood & fire resistance, security...

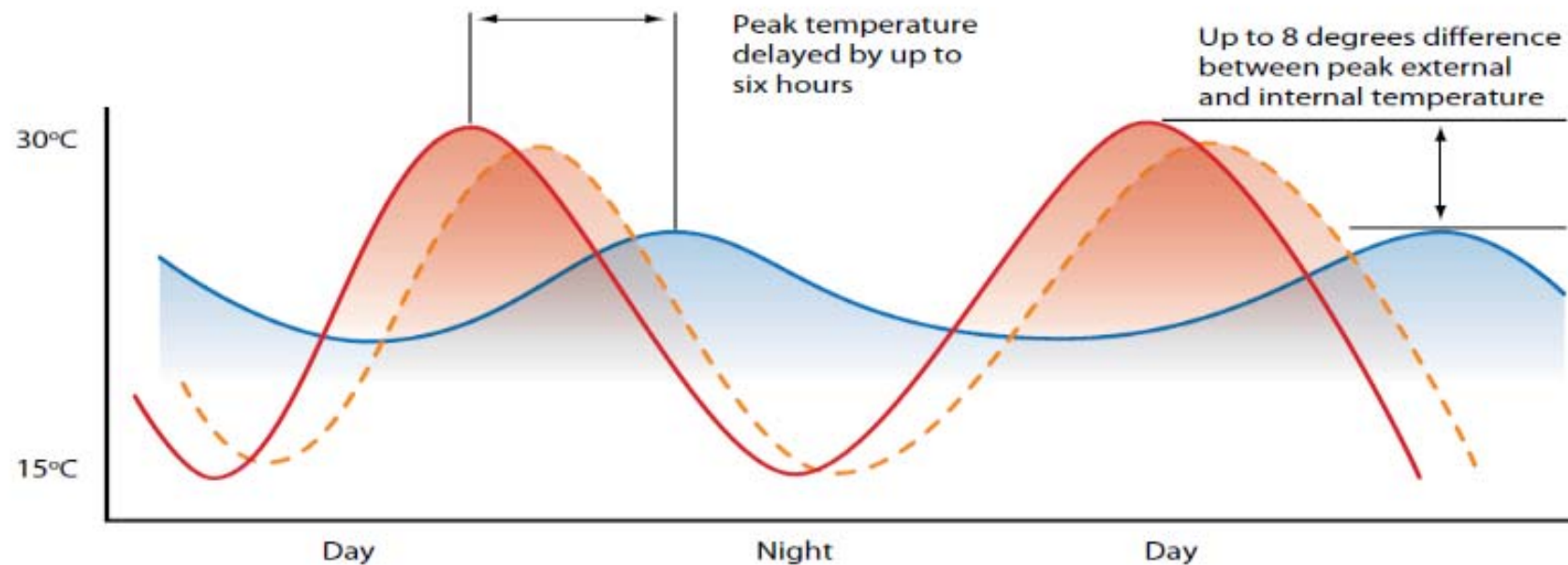
Thermal performance

The ZERO CARBON HOME - 2016



	Low-rise Apartment Block, average per unit	Mid- terrace house	End terrace house	Detached house
Carbon Compliance level* kgCO ₂ (eq)/m ² /year	14	11	11	10
* In addition to meeting the CO ₂ targets 2016 compliance will also require that the fabric performance requirements specified in the Fabric Energy Efficiency Standard (FEES) for zero carbon homes, these are currently set at 39 kWh/m ² /year for apartment blocks and mid-terrace houses, and 46 kWh/m ² /year for semi-detached, end of terrace and detached houses.				

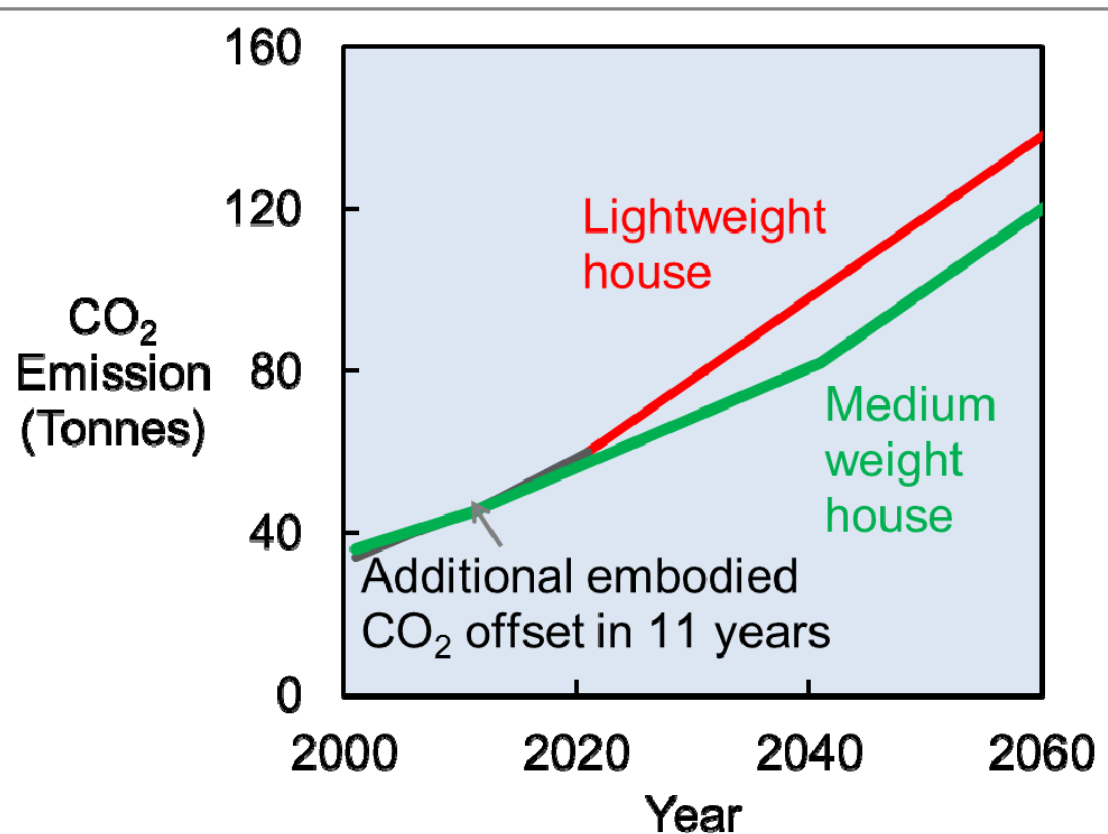
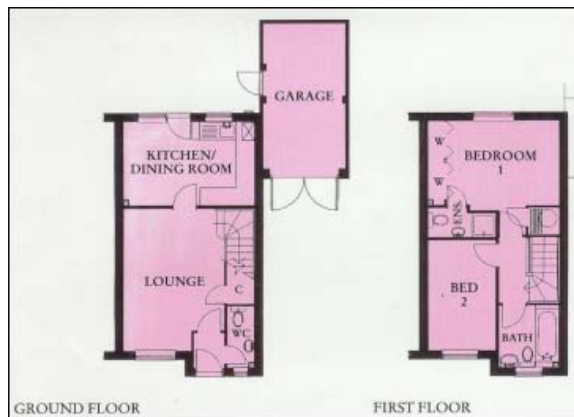
Thermal mass - overheating and operational energy



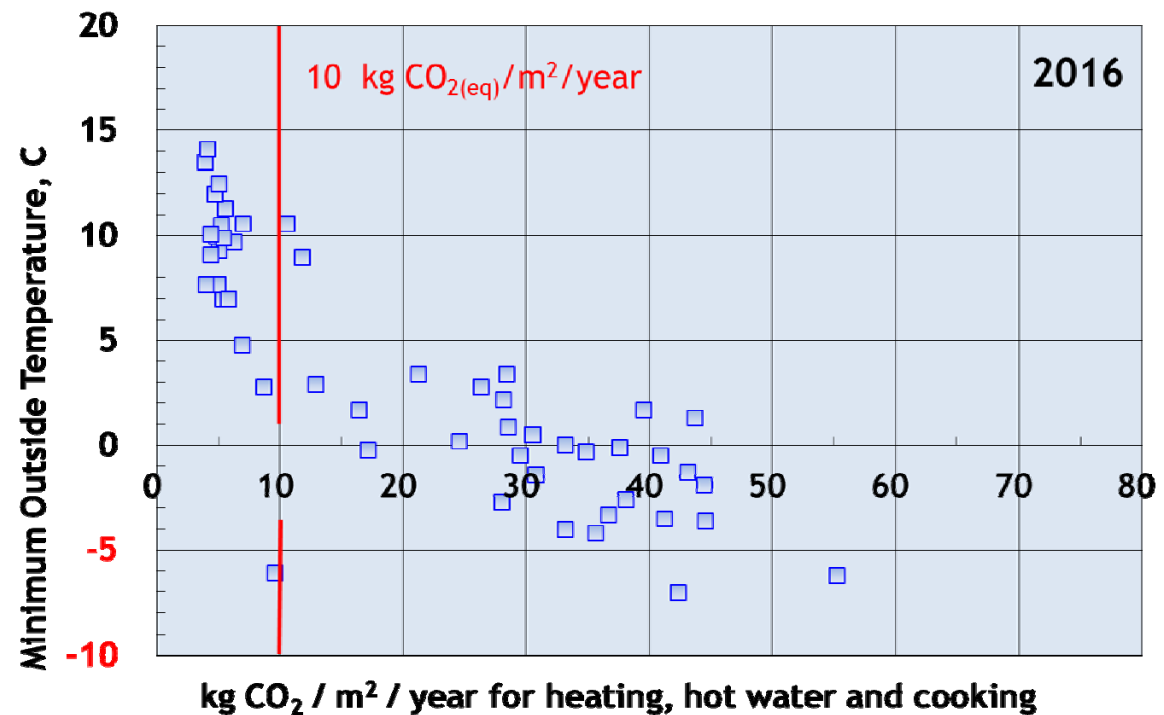
Overheating, two consecutive days and intervening night -
1 June to 15 September

Region	Day max, °C	Night min, °C
North East England	28	15
London	32	18

Cumulative CO₂ emissions, air-conditioned



Performance of a UK 1968 traditionally built house [+cavity wall insulation, double glazed, 2008 boiler]



EN 15643-2 Further environmental indicators (informative)

environmental impacts (LCIA impact categories)	resource use (environmental aspects) non-renewable	resource use (environmental aspects) renewable	other environmental information (environmental aspects)
<ul style="list-style-type: none"> – biodiversity – ecotoxicity – human toxicity – land use change 	<ul style="list-style-type: none"> – use of non-renewable resources other than primary energy 	<ul style="list-style-type: none"> – use of renewable resources other than primary energy 	<ul style="list-style-type: none"> – use of environmentally sustainably managed materials (grouped per material type e.g. PEFC, FSC, responsibly sourced materials BS 8902:2009) – use of environmentally sustainably managed fuels (grouped per fuel type e.g. Sustainability criteria for bio-fuels ISO 13065)

Responsible sourcing...

responsibly
sourced

this is
concrete



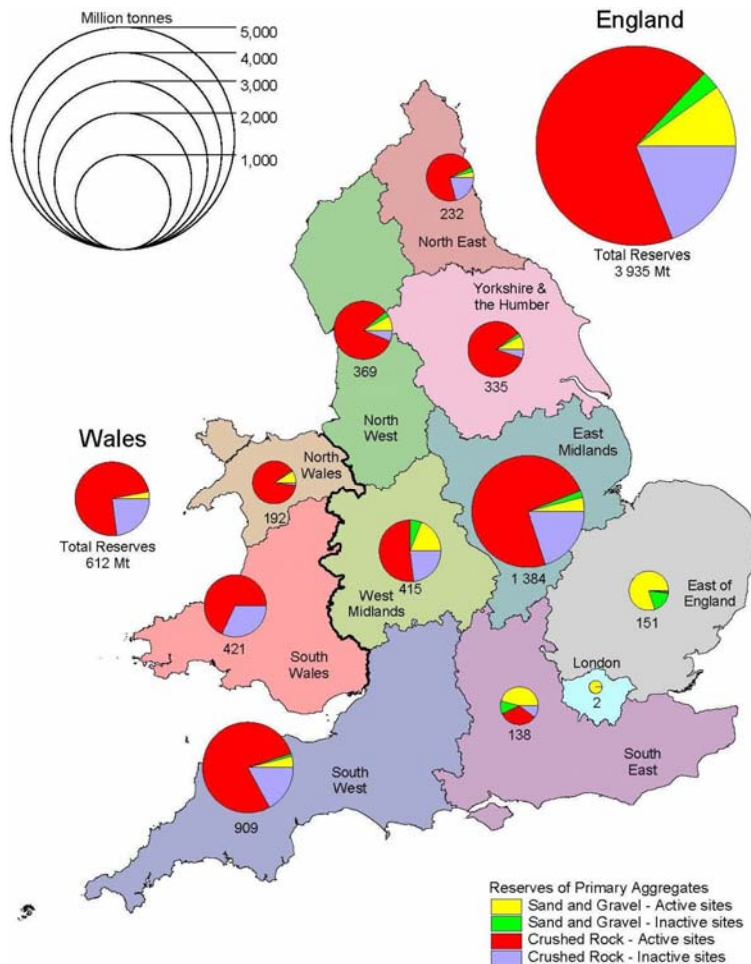
This concrete is **responsibly sourced**
and certified to **BES6001**

this is
concrete

EN 15643-2 Environmental indicators

environmental impacts (LCIA impact categories)	resource use (environmental aspects) non-renewable	resource use (environmental aspects) renewable	other environmental information (environmental aspects)
<ul style="list-style-type: none"> — abiotic depletion potential (elements and fossil fuels) — acidification of land and water resources — destruction of the stratospheric ozone layer — eutrophication — formation of ground-level ozone — global warming potential 	<ul style="list-style-type: none"> — use of non-renewable(NR) primary energy excluding NR primary energy resources used as raw materials — use of NR primary energy resources used as raw materials — use of NR secondary fuels 	<ul style="list-style-type: none"> — use of renewable(R) primary energy excluding R primary energy resources used as raw materials — use of R primary energy resources used as raw materials — use of secondary materials* — use of R secondary fuels — use of freshwater resources* 	<ul style="list-style-type: none"> — components for reuse — materials for recycling — materials for energy recovery — non-hazardous waste to disposal — hazardous waste to disposal (other than radioactive waste) — radioactive waste to disposal — exported energy

Resource use - permitted UK reserves of aggregates for 40 years



**Land won
sand and
gravel**

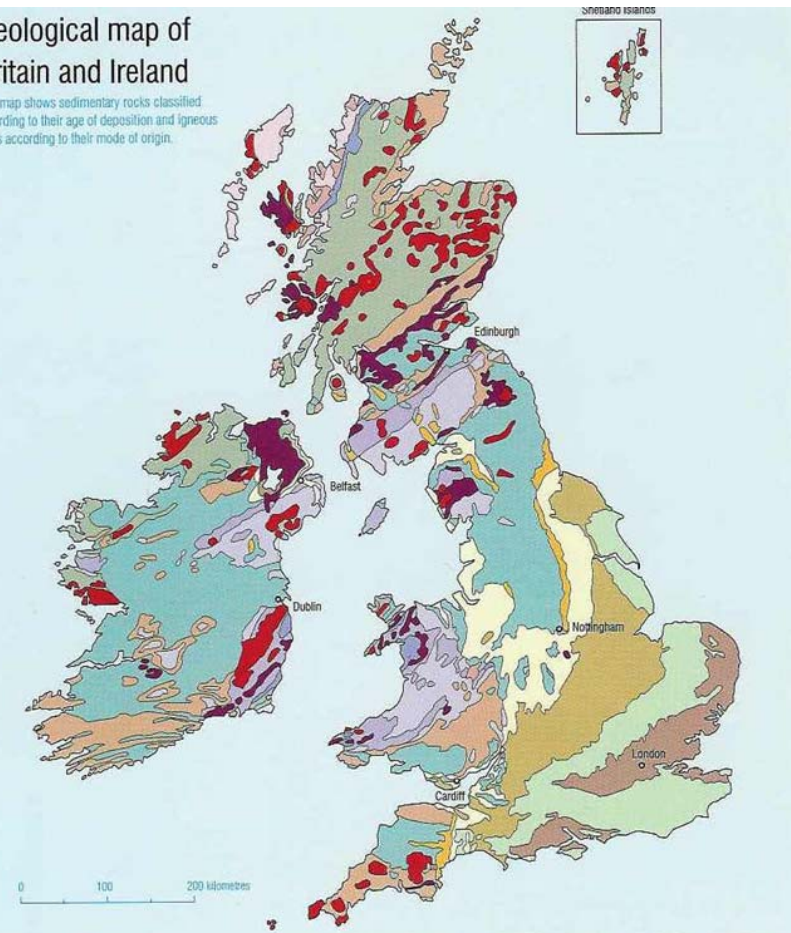
**Sand and
gravel
inactive
sites**

**Crushed
rock**

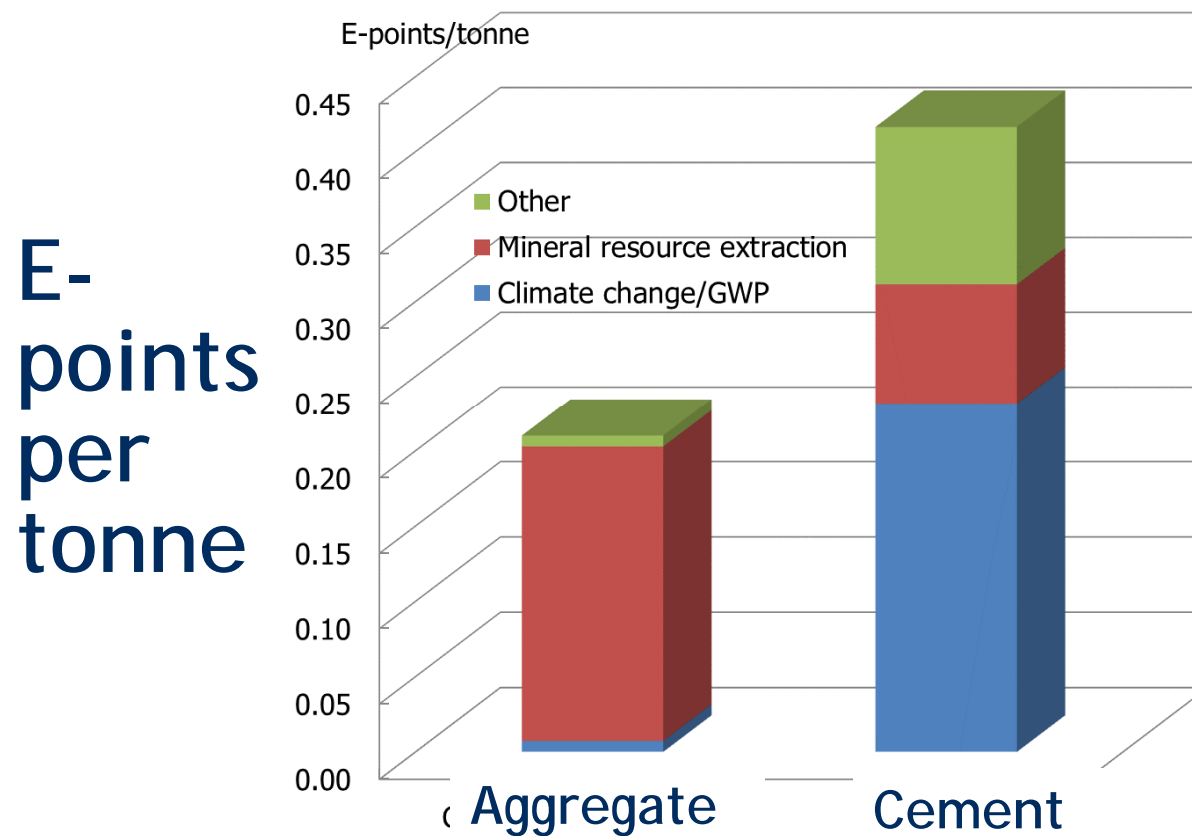
**Crushed
rock
inactive
sites**

Geological map of Britain and Ireland

This map shows sedimentary rocks classified according to their age of deposition and igneous rocks according to their mode of origin.



Simplifying Environmental and other impacts into a single score, E-points



Environmental impact of 1 tonne of cement equivalent to 2 tonnes of aggregate?

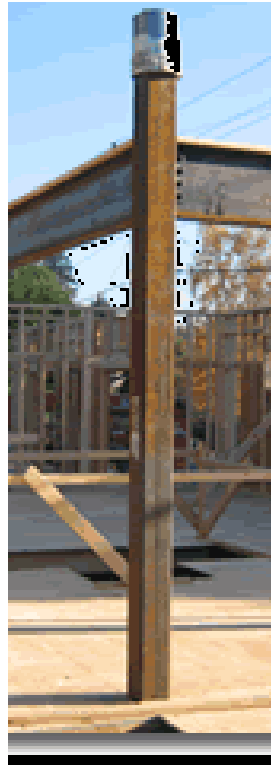
Aggregates, always recovered and reused



Comparison of construction materials



**Reinforced
Concrete**



Steel



Timber

Impacts - Office and Healthcare

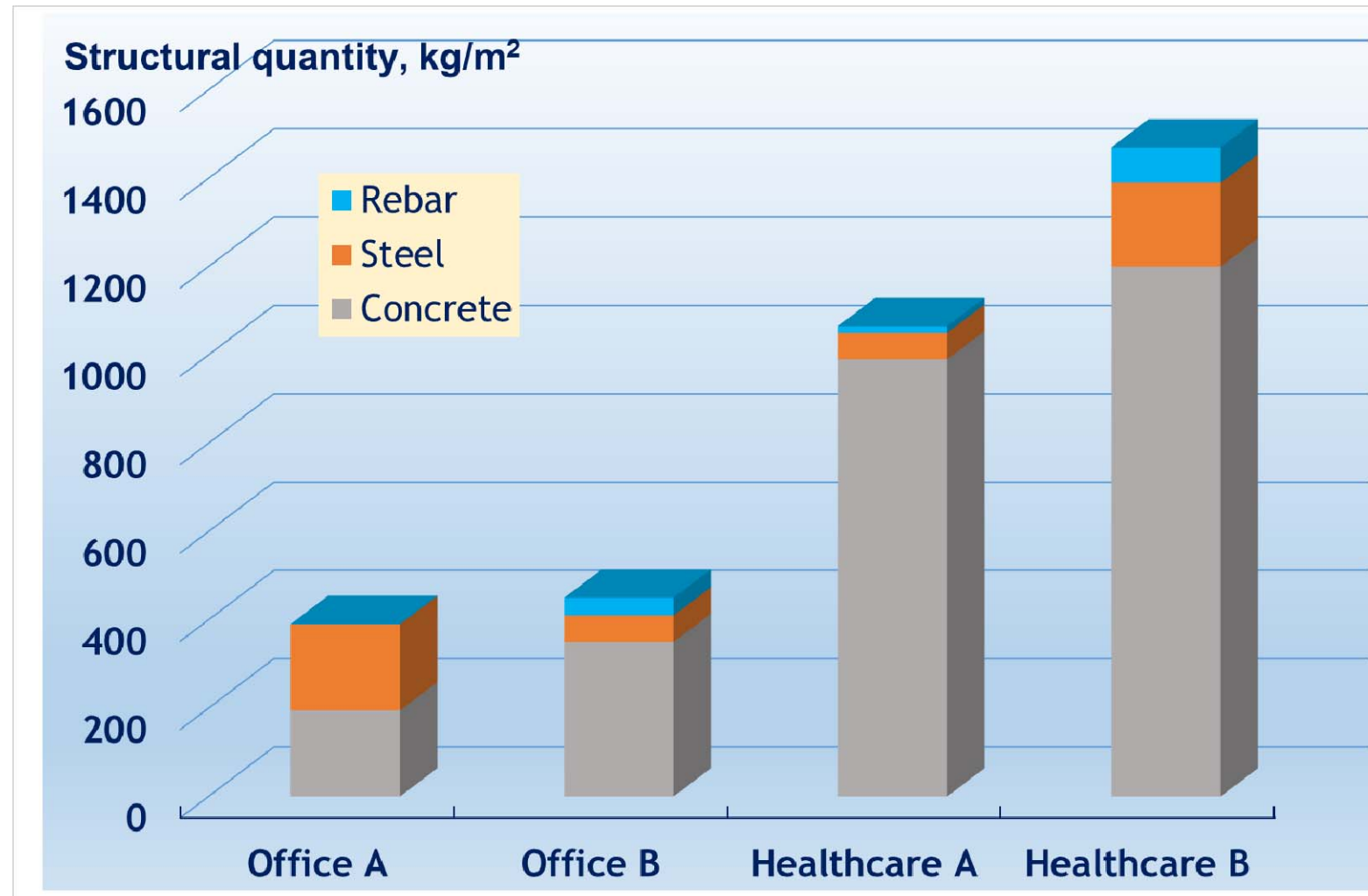
*Resource
use*

*Global
warming
potential*

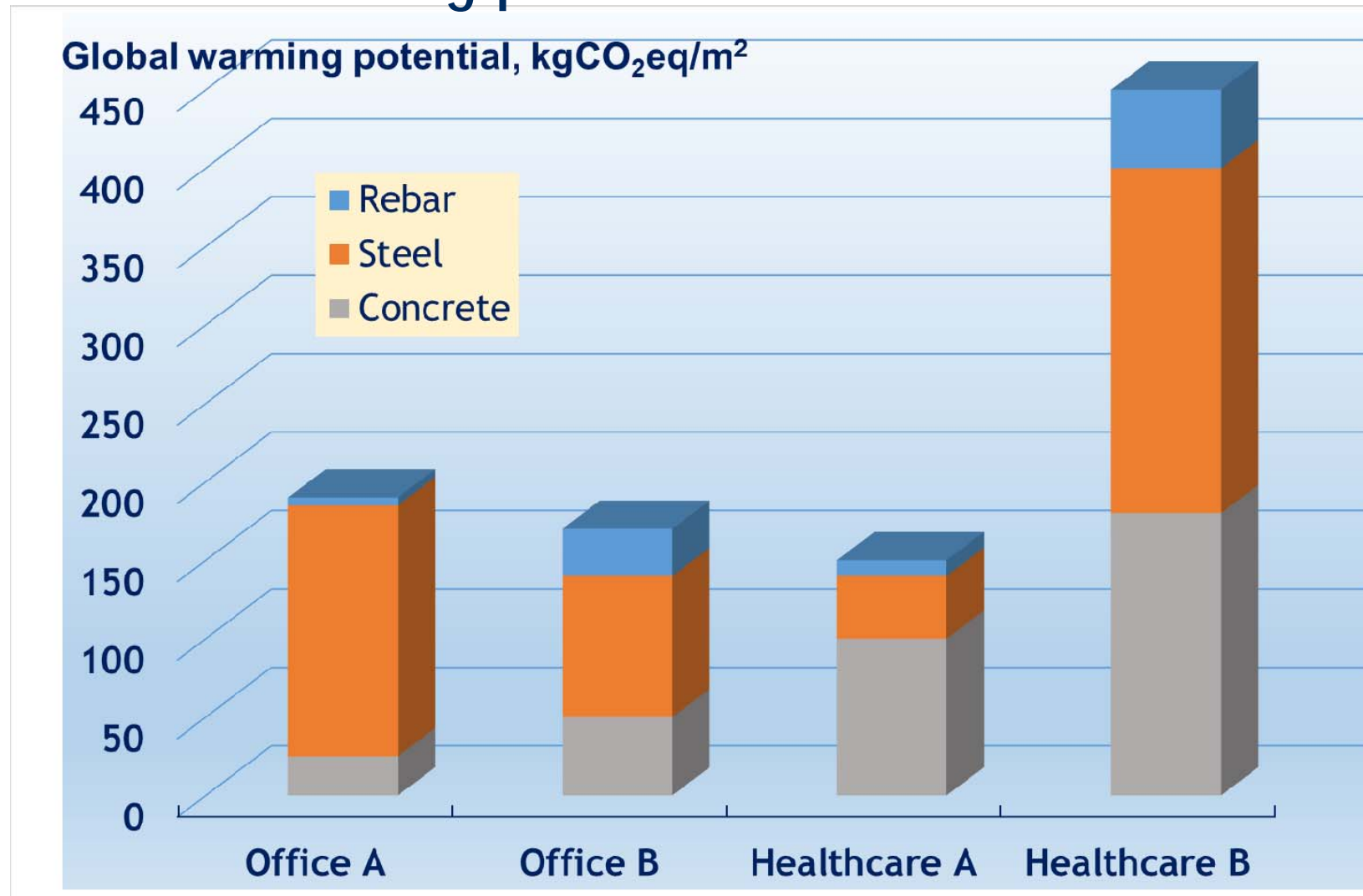
Material	kgCO ₂ e /kg
Structural steel	0.89
Reinforcement	1.40
Concrete	0.10



Resource use



Global warming potential



Concrete is sustainable...

Sustainability benefits

Cost and value

*Thermal performance,
maintenance, flood &
fire resistance,
security...*

Responsible sourcing...

Sustainability calculations

*Resource
efficiency,
global
warming
potential,
waste*

Specifying Sustainable Concrete

[*www.sustainableconcrete.org.uk*](http://www.sustainableconcrete.org.uk)

Sustainable Concrete

The leading material in Sustainable Construction

About us

UK Construction Industry

Concrete Sustainability Strategy

What is

Biodiversity

CO2 Emissions

Emissions excluding CO2

Employment and Skills

Energy Efficiency

Environmental

Sustainable Concrete

Sustainable Concrete aims to provide context and signpost visitors to information about the end-use of concrete, as well as inform on the latest sustainability performance information for the manufacture and production of concrete. The performance indicators used by the concrete industry to the Green Construction Board's "Greening the Industry" initiative.

ACTION on Materials

- Environmental Management



Green concrete, sustainable concrete



Garden bridge,
footbridge across
Thames

