Measuring the Impact of Building Materials and the Opportunity for Wood-Based Construction

12 October 2010

Dr Ed Suttie
BRE Timber

Introduction

- Construction industry drivers
- Key construction materials
- Carbon and wood use
- The sustainability framework in the UK
- How can wood use in construction increase?
- Constructing the Future
- The Olympics London 2012
- Conclude

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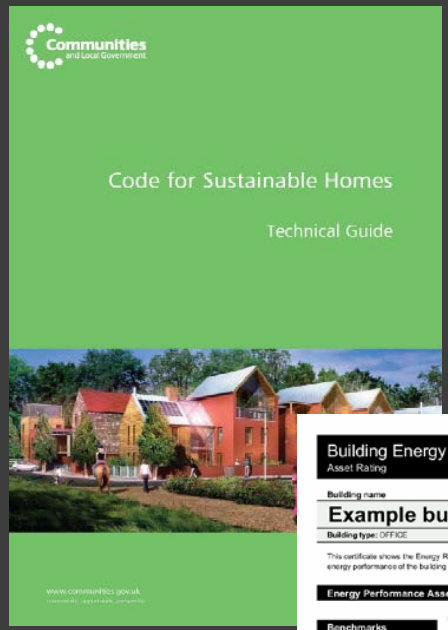
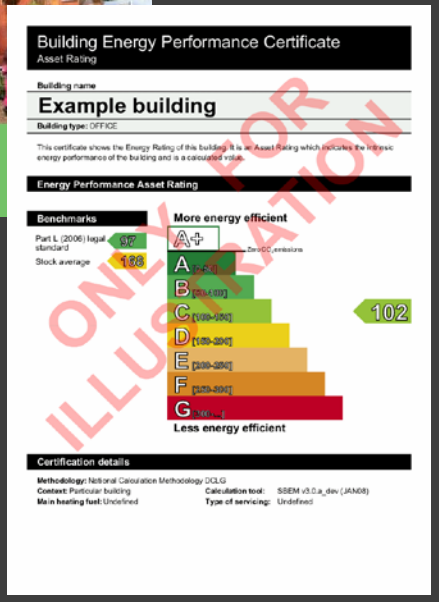
Regulatory change





All new build homes to be zero carbon by 2016

All non-domestic buildings to be zero carbon by 2019

An increase in renewable energy generation from 1% to 15% by 2020

Kyoto – reduce UK carbon by 80% by 2050

Energy Performance of Buildings Directive

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CLIMATE CHANGE

- More forest and woodland area
- Fuel substitution
- Material substitution: increased use of wood and wood based products

Wood in construction

- Versatile material
- Strong and light (structural frame, roof)
- Engineered panels (sub-floors, joists, wall panels, SIP)
- Thermal insulator (insulation)
- High aesthetic (floors, joinery, furniture, cladding)
- Biomass boiler

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Construction and the built environment impacts

- 50% of UK carbon emissions
- 50% of water consumption
- 35% of landfill waste
- 13% of all raw materials used in the UK economy
- 94 million tonnes of demolition waste annually

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UK construction industry

- £80bn industry 10% GDP
- 1.4m people employed
- 420m tonnes materials used
  - 15m tonnes timber
  - 90% in RMI
- Timber frame 22% new housing market
- 50% of all energy generated is operational energy for buildings

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Concrete in construction

- 5% annual anthropogenic CO_2
- CO_2 product of cement reaction
- Widely used 2bn tonnes per annum and rising
- Calcium silicates formed up to 1500^{o}C ⇨ cement
- 800kg CO_2 per tonne

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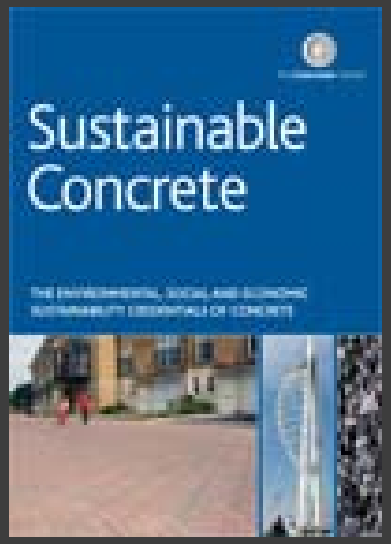
Concrete: Improving sustainability

- Energy efficiency
- Increased water reuse
- Dust emissions down
- Recycled/reclaimed aggregates and clinkers
- Advance admixture chemistry
- Reducing CO_2 per tonne
- Low impact cement is here…
- Net CO_2 absorption as it cures



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Steel in construction

- 10-15% CO_2 emissions in China, Brazil, South Africa, India
- Old inefficient technologies burning coke or charcoal as fuel
- 30-50% of primary energy input can be saved
- 20% CO_2 emission reduction by 2020 compared with1990
- Ultimate recyclability – ‘multicycled’
- 500m tonnes recycled per annum
- UK structural steel is >60% recycled content
- >97% steel in UK construction on demolition is recovered

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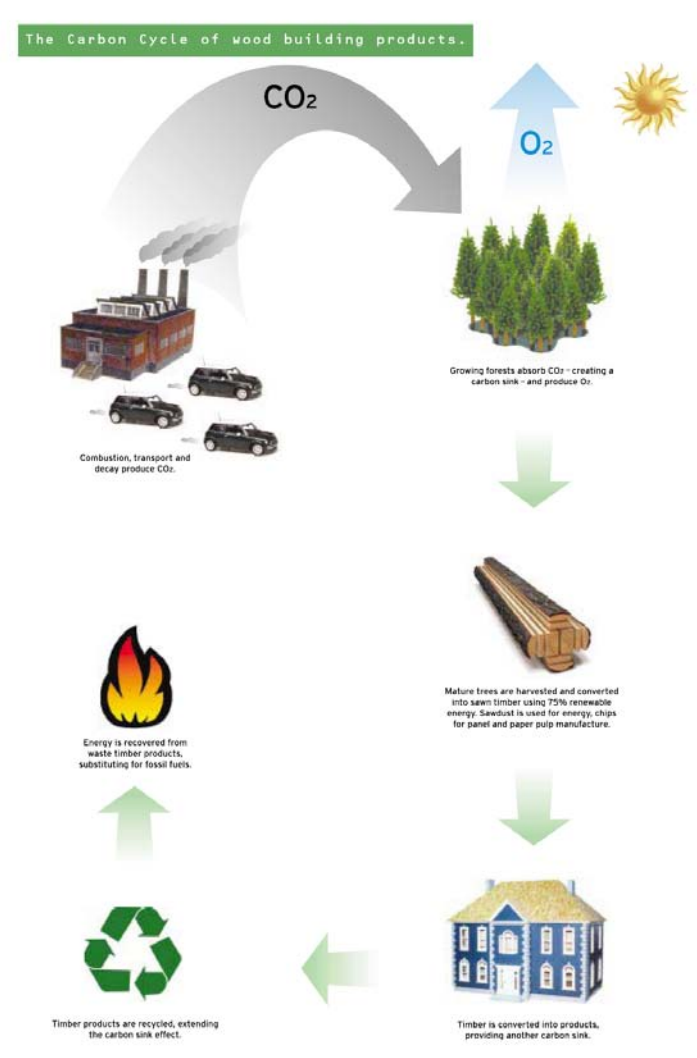
Timber in construction



- Renewable
- Stores carbon
- Rural communities
- Employment diversity
- Energy recovery

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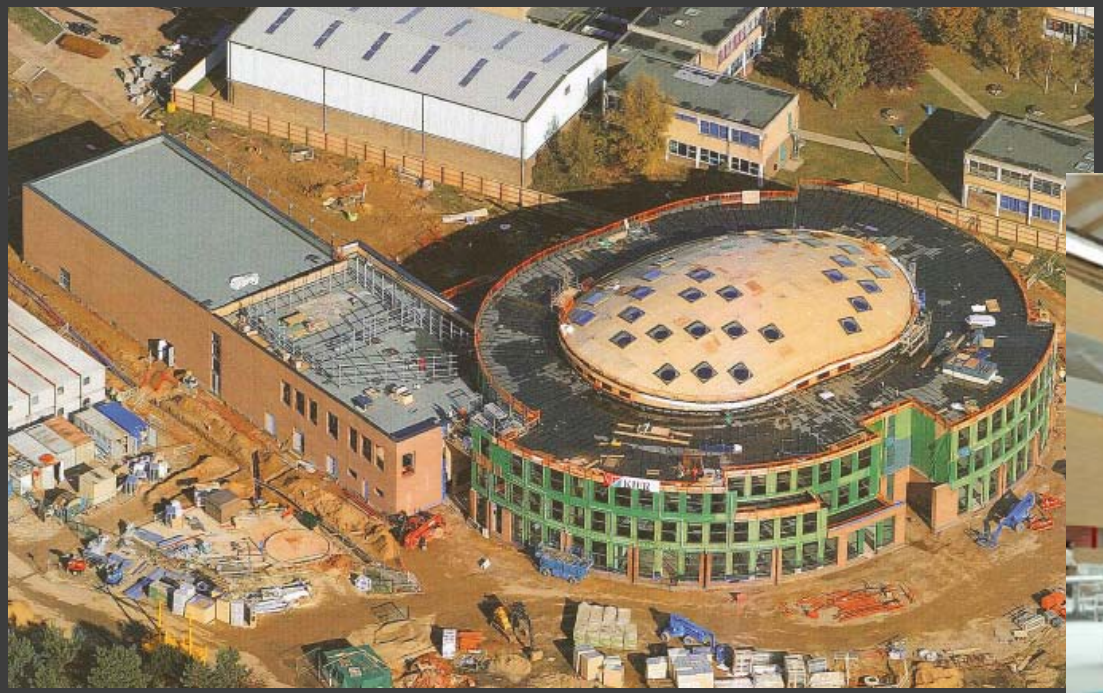
Norwich Academy

- UK’s largest new build school
- 3500m^3 timber and 2900t CO_2 stored



Timber

- Focus on renewable resource and sequestration of CO_2
- "….1m^3 concrete/red brick with timber we save 1 tonne of CO_2"
- "…substituting 1m^3 other building materials with wood stores on average 0.8 tonnes of CO_2"
- "…timber buildings achieve negative net CO_2 emissions…"
- CO_2 kg/m^2 of building area:
  - Concrete 11.1 Steel 5.2 Timber 1.4
- 20 tonnes CO_2 emitted in typical house
- 2.4 tonnes CO_2 emitted in the same house if timber maximised
- Is this enough?

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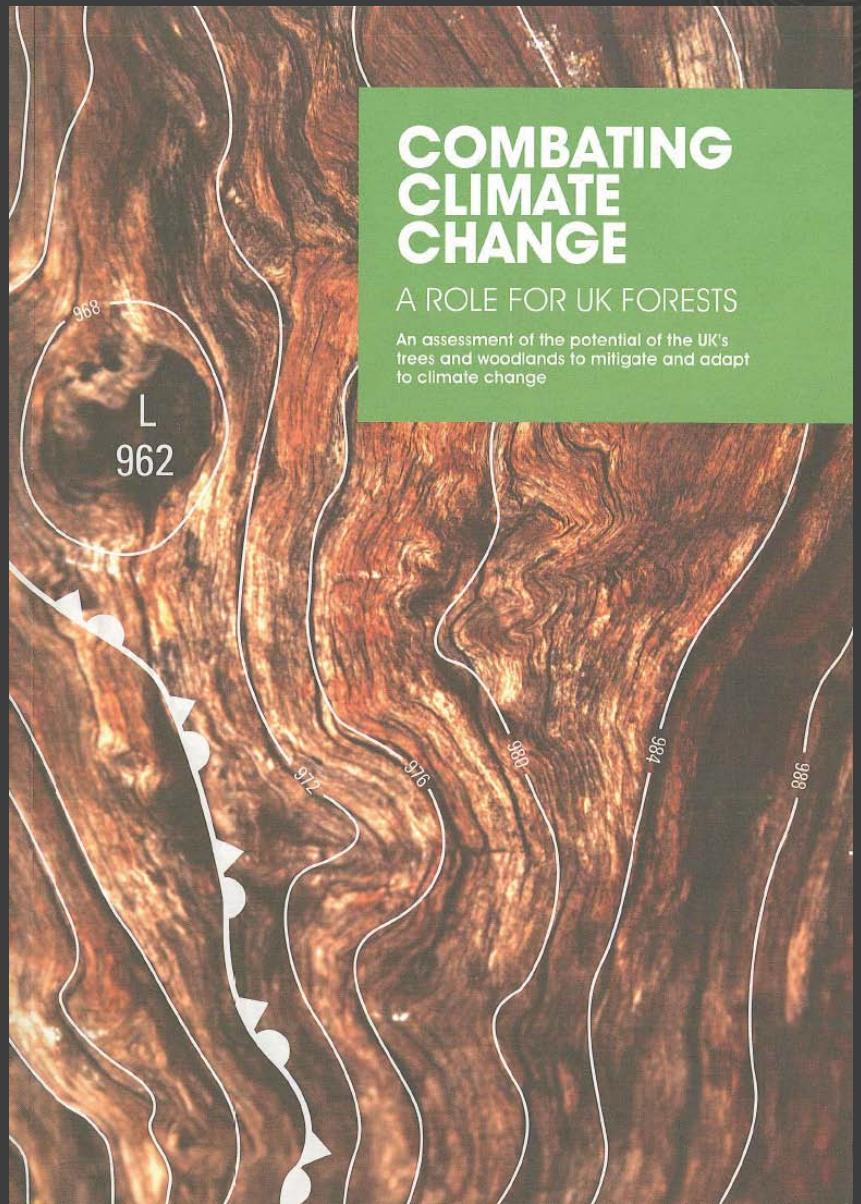
Combating Climate Change

- November 2009
- Role for UK forests
- The Read report



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The Read report Chapter 7

- Climate Change fundamentally alter markets for wood energy and wood products
- Taxation, regulation and other mechanisms will alter product competitiveness
- Estimate 19MtC stored in timber in housing
- 150MtC released per annum from fossil fuel use
- Possible to store an additional 2-5MtC in new and refurbished housing per annum
- Construction slow to change

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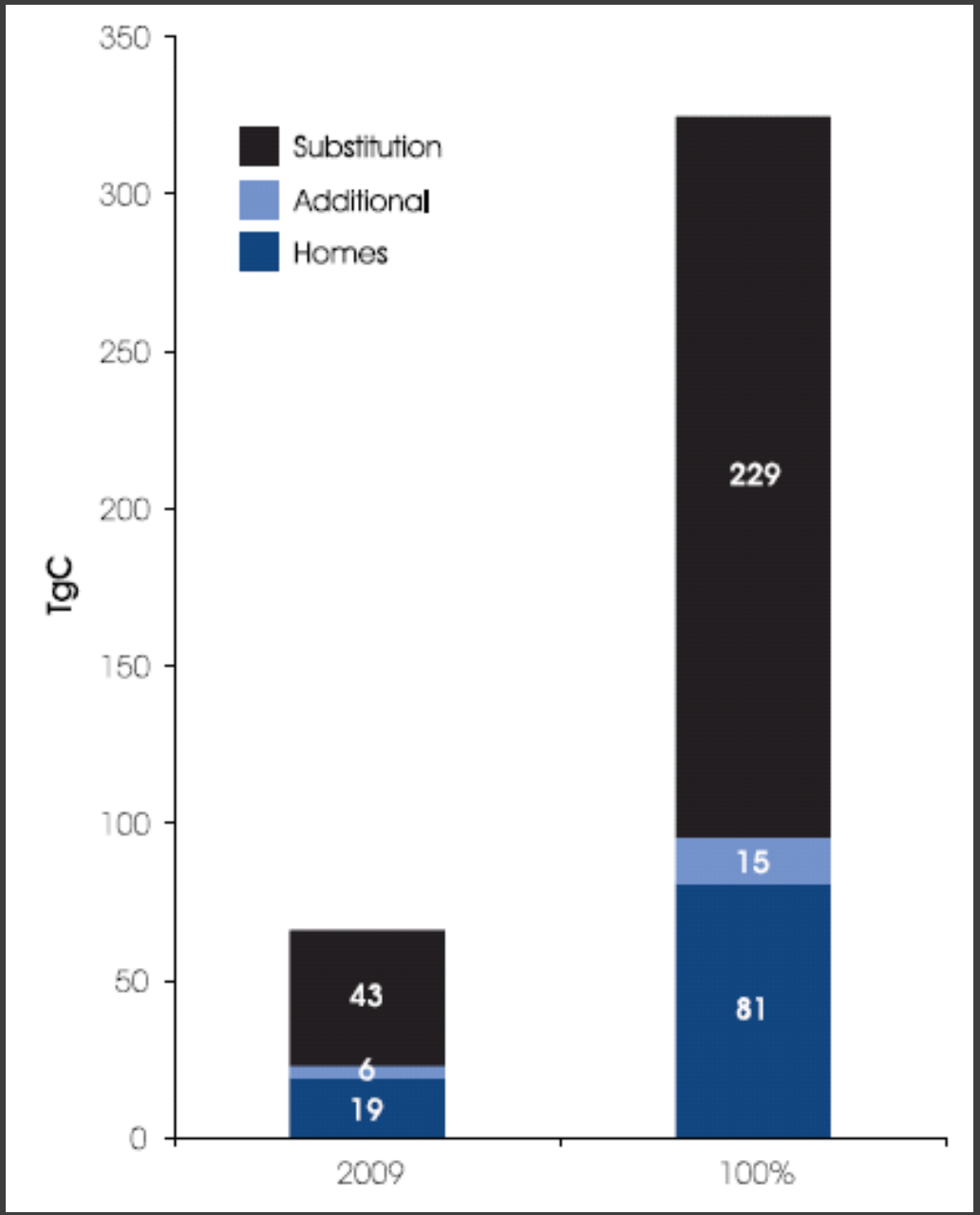
350
300
250
200
150
100
50
0
TgC
Substitution
Additional
Homes
43
6
19
229
15
81
2009
100%

How can wood use increase in construction?

How can wood increase in construction?

- Intervention
  - Government initiatives
  - Tax incentives
  - Carbon accounting
- Drivers that support wood product specification
  - Sustainable construction
  - Low carbon
  - Green Guide
  - Code for Sustainable Homes
- Innovations that problem solve
- Delivery meeting client needs

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Government decree proposed in France

- Promote the use of wood and bio-based materials in construction
- The amount of wood to be included in the building is measured as volume compared to total net floor area of the building
- $70m^2$ UK home
- Before Dec 2011 $70 \times 0.020m^3 = 1.40\ m^3$
- After Dec 2011 $70 \times 0.035m^3 = 2.45\ m^3$

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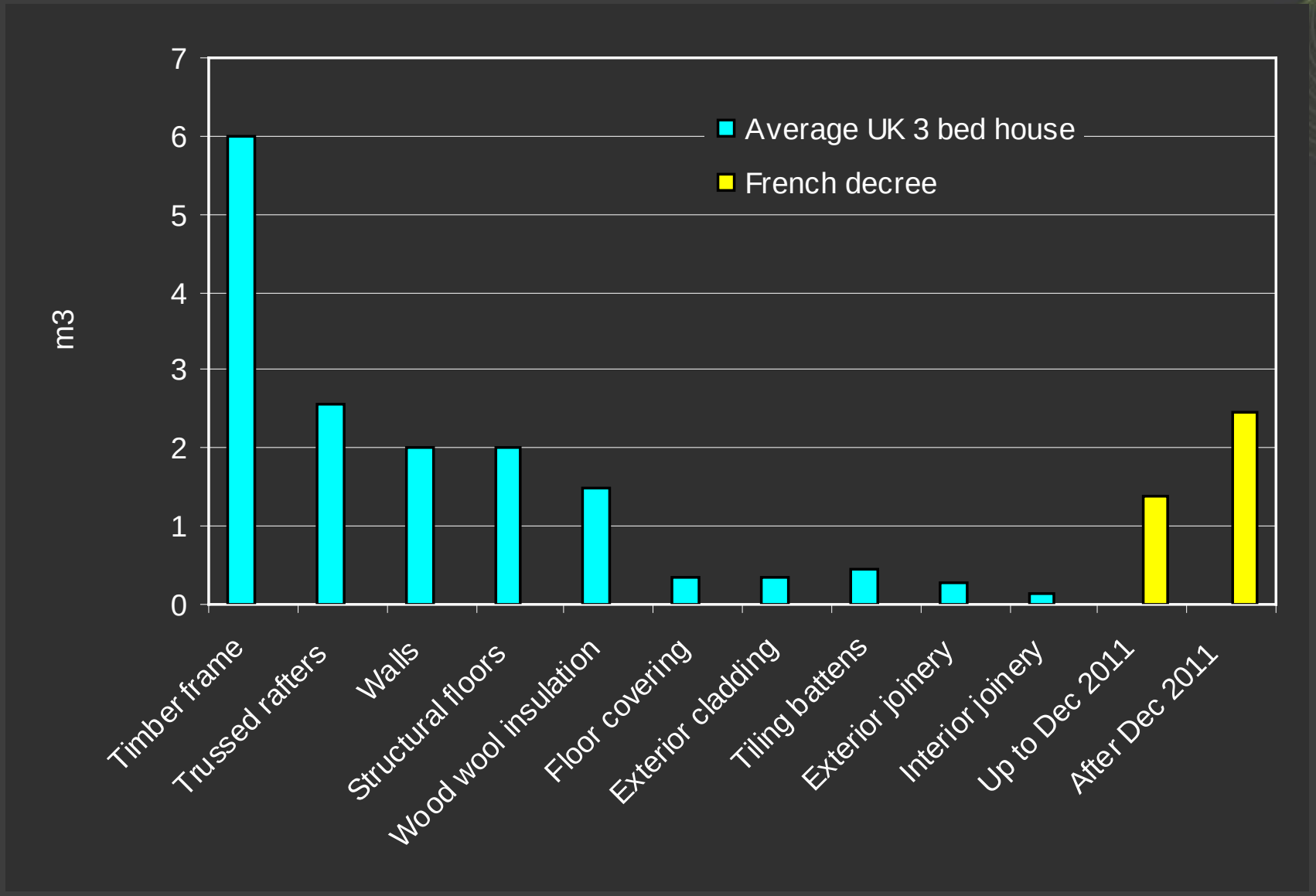
m3
7
6
5
4
3
2
1
0
Average UK 3 bed house
French decree
Timber frame
Trussed rafters
Walls
Structural floors
Wood wool insulation
Floor covering
Exterior cladding
Tiling battens
Exterior joinery
Interior joinery
Up to Dec 2011
After Dec 2011

Provision of sustainable buildings

Comfortable, healthy internal conditions are achieved, whilst minimising environmental impact associated with construction and operation

Four key principles :

- Reducing embodied energy and resource depletion
- Reducing energy in-use
- Minimising external pollution and environmental damage
- Minimising internal pollution and damage to health

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Instruments for sustainable construction

- Life Cycle Assessment
- BREEAM Ecohomes
- The Code for Sustainable Homes
- The Green Guides

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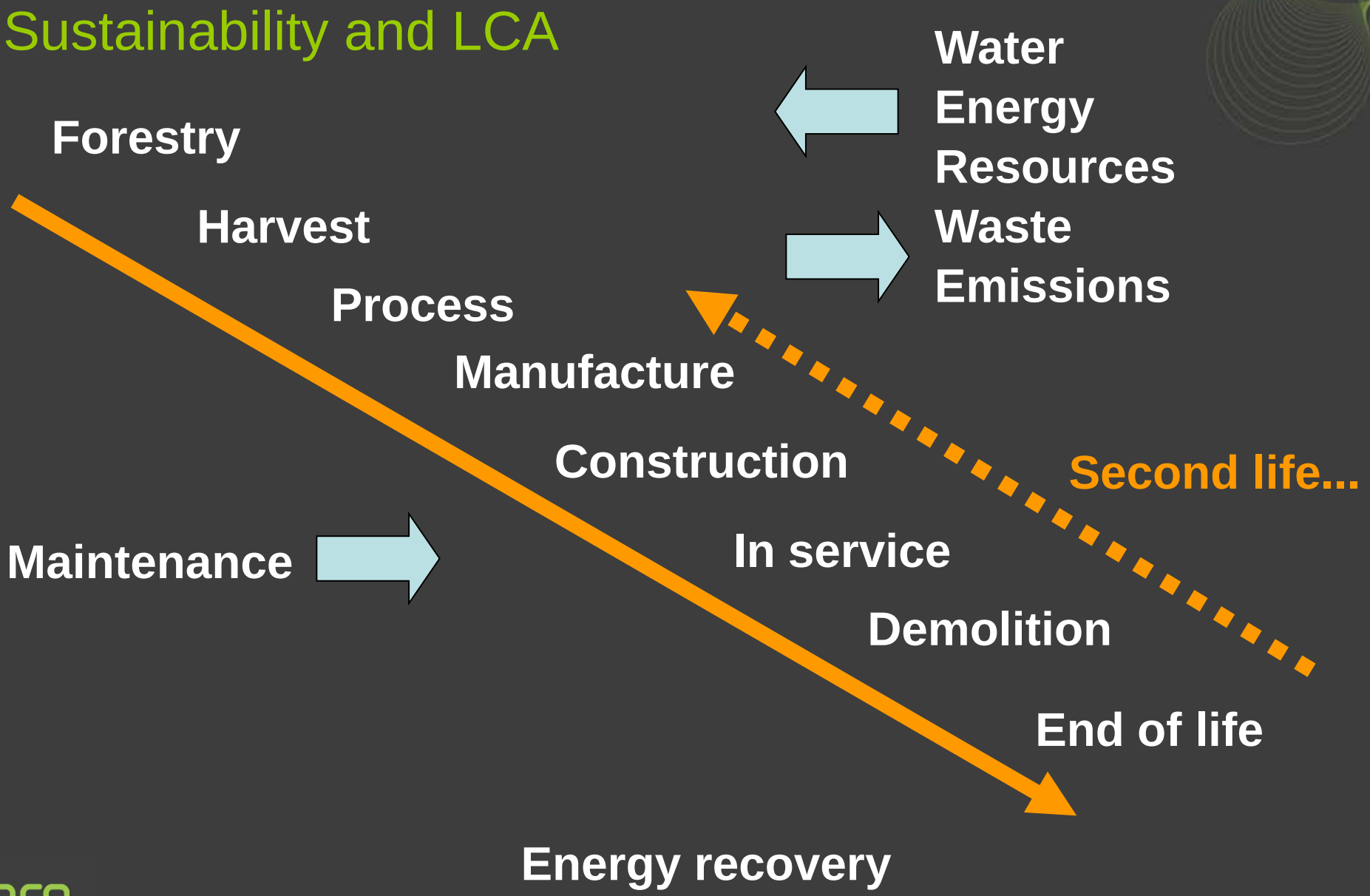
Sustainability and LCA



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Schemes for the environmental assessment of buildings

Based on:

- Assessment at the design and operational stage
- Performance against a broad range of key environmental criteria
- The award of a ‘visible’ certificate and detailed report
- Ranked on scale:
  - Pass
  - Good
  - Very Good
  - Excellent

BREEAM

- BREEAM assesses the performance of buildings in the following areas:
  - Management: overall management policy, commissioning site management and procedural issues
  - Energy use: operational energy and carbon dioxide issues
  - Health and well-being
  - Pollution: air and water pollution issues
  - Transport: transport-related CO_2 and location-related factors
  - Land use: greenfield and brownfield sites
  - Ecology: ecological value conservation and enhancement of the site
  - **Materials: environmental implication of building materials**
  - Water: consumption and water efficiency

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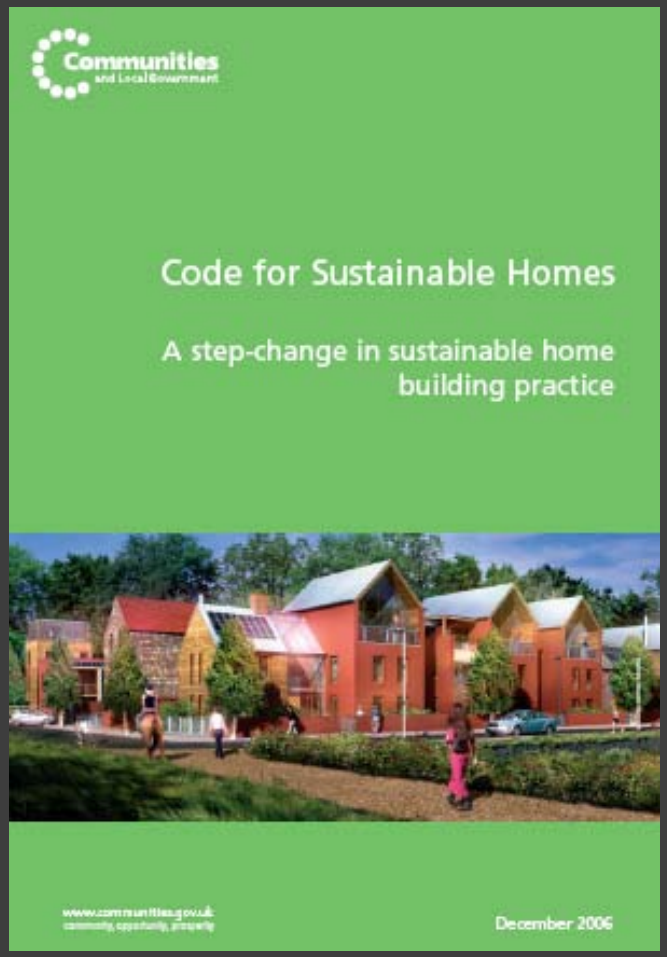
The Code for Sustainable Homes 2007



- Single national standard for England replacing Ecohomes
- Industry guide for design and construction for more sustainable new homes
- A step change in sustainable building practice for new homes
- Green Guide support

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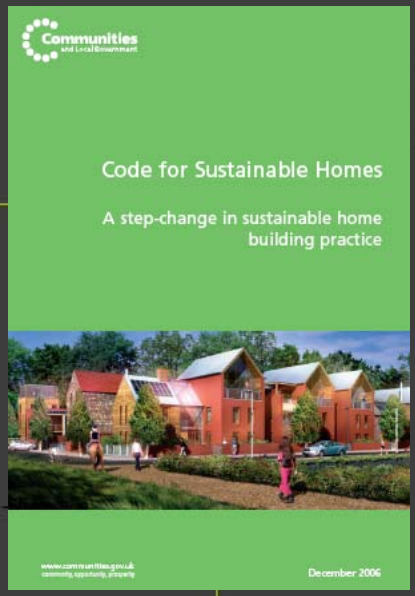
Mandatory Standards

- Energy
- Potable Water Consumption
- Waste
- Materials
- Water Surface Run-off



Tradable Credits

- Energy
- Potable Water Consumption
- Waste
- Materials
- Water Surface Run-off
- Pollution
- Health & Wellbeing
- Management

Issue Category Scores

Environmental Weightings

Overall Score

- Level 1
- Level 2
- Level 3
- Level 4
- Level 5
- Level 6

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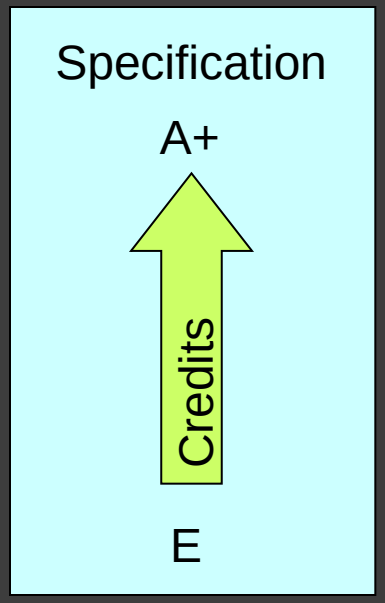
The Code for Sustainable Homes

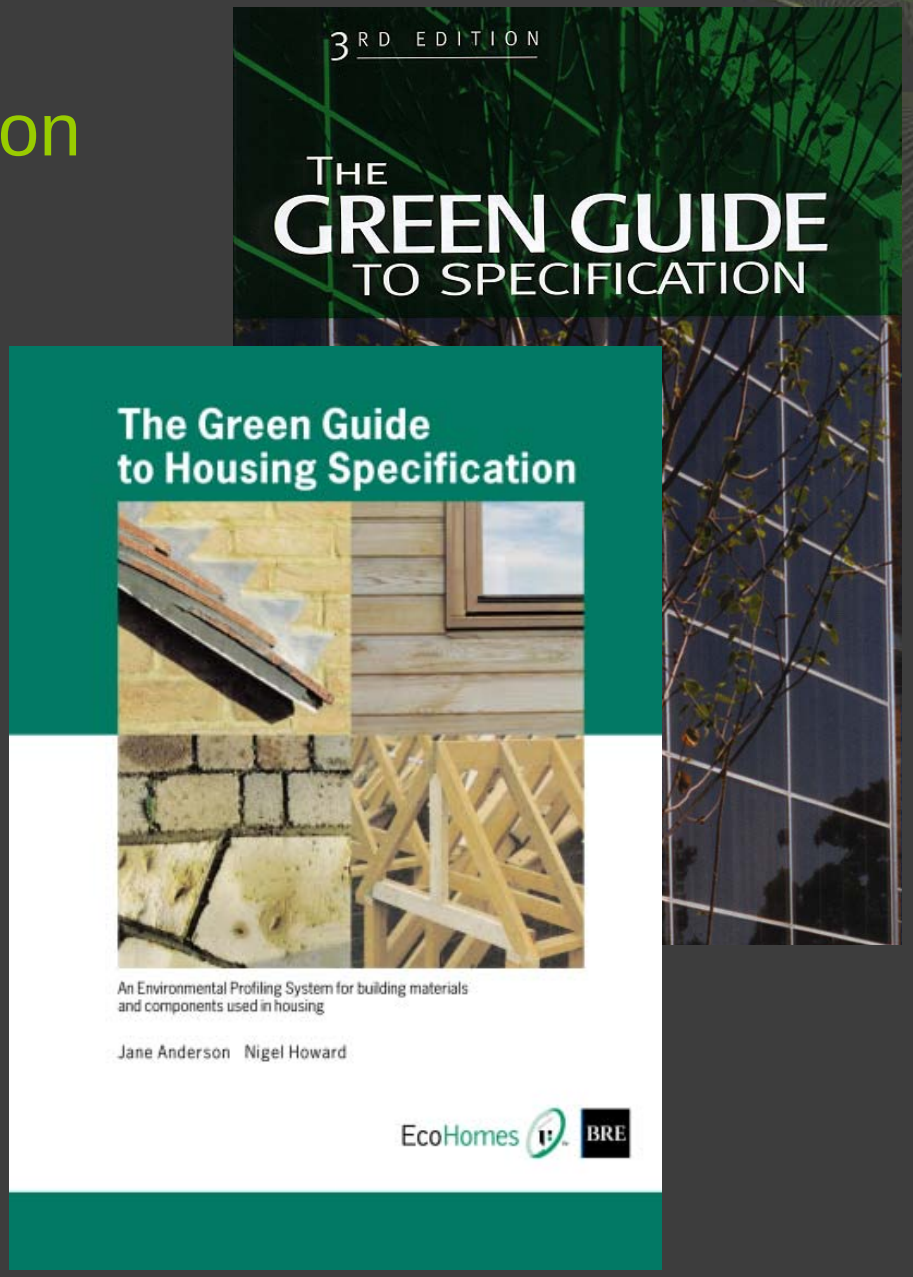
Most relevant credit:

- Mat 1: Environmental Impact of Materials
- Use Green Guide A+ to E ratings
- Awards points based on element ratings
- Minimum standards



Green Guide for Specification

- Environmental impacts of building elements
- LCA
- A+ to E ratings
- Supports the Code and Ecohomes



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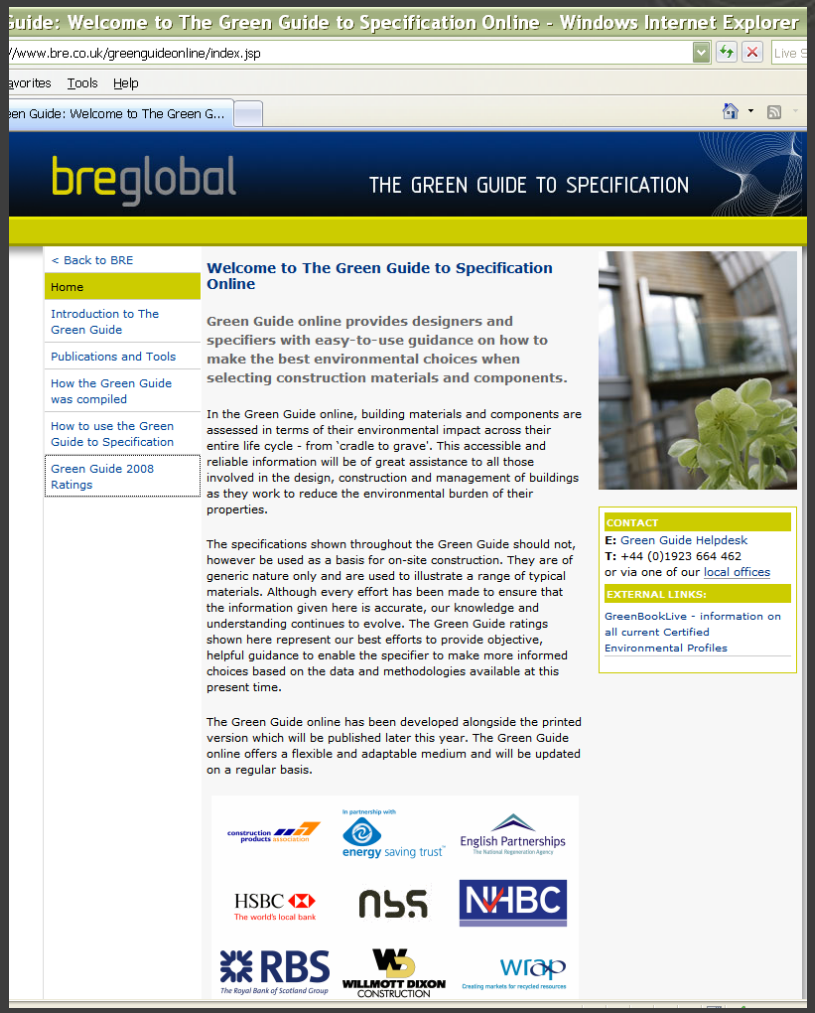
Online Green Guide: Supporting specifiers

- Online
  - 1500 generic specifications
  - 200 proprietary specifications
  - Six building types

- FREE access
- www.thegreenguide.org.uk



< Back to BRE
Home
Introduction to The Green Guide
Publications and Tools
How the Green Guide was compiled
How to use the Green Guide to Specification
Green Guide 2008 Ratings

Green Guide 2008 ratings

Building type > **Domestic**

Please select an element

- Upper Floor Construction
- Ground Floor Construction
- Internal Wall
- Domestic Windows
- Roofing
- External Wall Construction
- Insulation
- Party Wall
- Party Floor
- Landscaping

CONTACT
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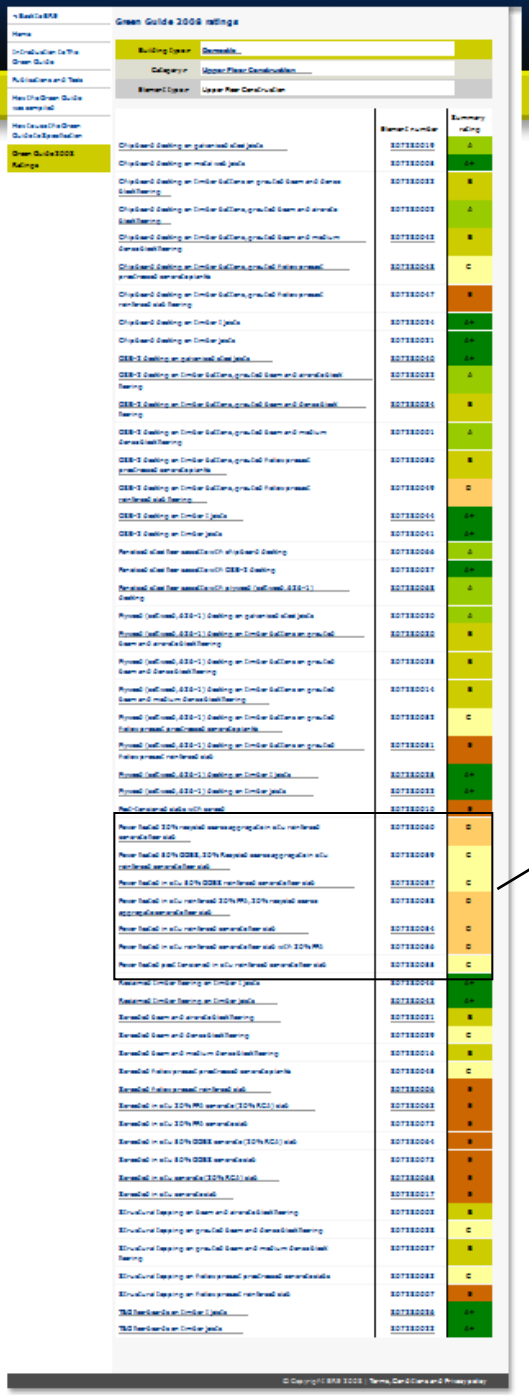
Upper floors



Power floated 20% recycled coarse aggregate in situ reinforced concrete floor slab	807280060	D
Power floated 50% GGBS, 20% Recycled coarse aggregate in situ reinforced concrete floor slab	807280059	C
Power floated in situ 50% GGBS reinforced concrete floor slab	807280057	C
Power floated in situ reinforced 30% PFA, 20% recycled coarse aggregate concrete floor slab	807280058	D
Power floated in situ reinforced concrete floor slab	807280054	D
Power floated in situ reinforced concrete floor slab with 30% PFA	807280056	D
Power floated post tensioned in situ reinforced concrete floor slab	807280055	C

How does wood do?

- Many wood and wood-based products feature favourably in the Green Guide rating system (A+, A)
- Job done?
- The scene is shifting
- Many generic products are not represented

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Innovative products for the UK

- We learn and continue to do so from other countries
- Technology transfer and adaptation
  - Cross laminated timber
  - Modified wood technologies
  - Healthy homes
  - Timber structures and bridges

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What do construction clients want?

- Chain of Custody
- Peace of mind (Responsible sourcing)
- Value for money
- Confidence in performance
- Homes to meet Ecohomes
- Credits in the Code

- These can and do override material preferences

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Constructing the future

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Increasing product requirements

- Performance
- Innovation and modern methods
- Security, health, durability
- Flood resilience and ease of repair
- Waste minimisation
- Sustainable, responsible
- Quality/performance differentiation
- Affordable design
- Adaptability and flexibility

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Responsible sourcing of materials

- Management systems
- Sustainable resource use
- Fundamental rights at work
- Ethics
- Health and safety
- Stakeholder engagement
- Legal compliance
- Complaints and prosecutions
- Site stewardship
- Waste management
- Local communities
- Water
- Employment and skills

Offsite construction

- Pre-manufacture
- Less storage area on site
- Quality of workmanship
- Improved safety levels
- Fast assembly
- Reduced costs
  - Lower labour costs
  - Less waste
  - Less plant hire
  - Dimensional accuracy
  - Less disruption

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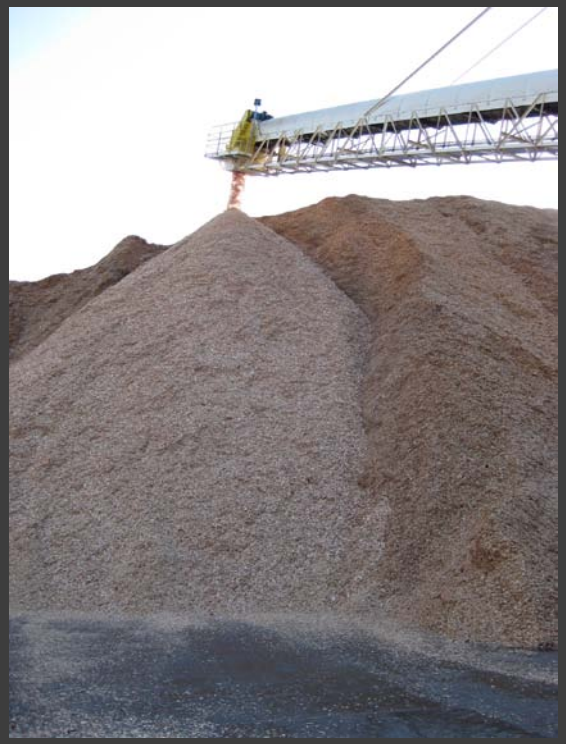
Factories of the future now

- Customer experience
- Quick and precise manufacture
- Rapid delivery and build

Improved processes

- Continuous improvement



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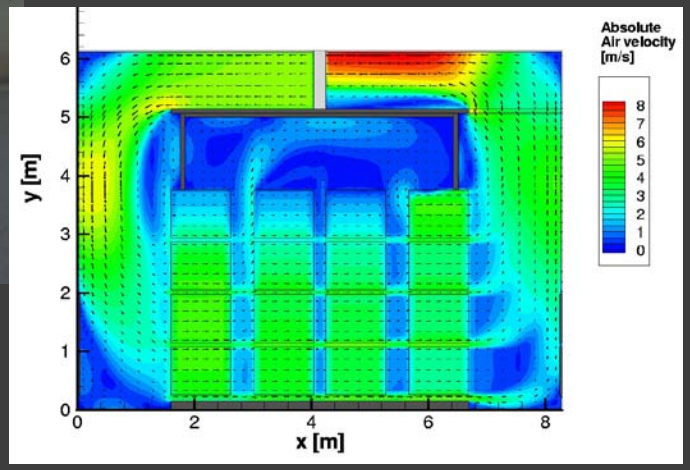
Tackling carbon impacts - energy efficiency



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Tackling problems - acoustic performance of floors

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Integrating new technologies e.g. wood modification

- Wood preservation - increasing restrictions on traditional products
- Chemical modification
- Thermal modification

Service life prediction

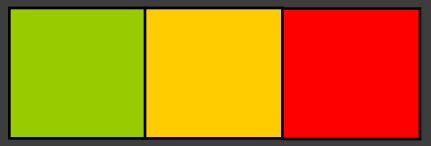
- Durability/Material
- Service life
- Building location
- Design/aspect/elevation
- Coating
- Maintenance

Microclimate

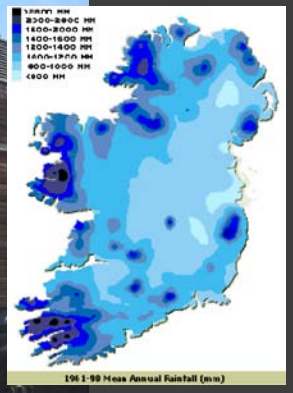
Mesoclimate

Macroclimate

Fitness for purpose



(different limit states)



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Raising standards – improving service life

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Local timber resources

- Quality
- Scale and capacity
- Supply chain
- Skills
- R&D to bridge gaps
- Investment
- Entrepreneurs

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Bringing it all together

Minimise waste and maximise recycling at end of life

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information paper

Best practice of timber waste management

IP 9/03

James Hurley, Katherine Adams, Angus McMinn and Wendy Thorpe

BRE Centre for Resource Management
BRE Centre for Timber Technology

This paper presents the practical issues that affect timber waste in UK construction. It describes timber sources, composition, use and waste, and markets for recycling and disposal together with the plant and machinery necessary to exploit this resource. It proposes a timber waste classification.
This material is then drawn together to provide the best practicable environmental option for timber waste; a model is tested to provide two examples of what could be achieved. The paper concludes with some suggestions of best practice for timber waste management and how these can be addressed by industry.

Timber is a major resource suiting many processes and functions. Managed and renewed effectively, it can provide a sustainable source of materials for the construction industry. Uniquely, timber waste offers industry opportunities for re-use, recycling and recovery rather than disposal – see box right.

The construction industry in Europe is at a turning point with waste minimisation and management and has been challenged by governments to reduce dependence on landfill and offer materials recovery services and recycling. Clients, planners, contractors and manufacturers have a part to play in achieving a more sustainable approach by extending the life cycle of timber products and resources and re-using and recycling timber products and materials into high-grade rather than low-grade applications; an example would be converting dimensional timber into a new window.

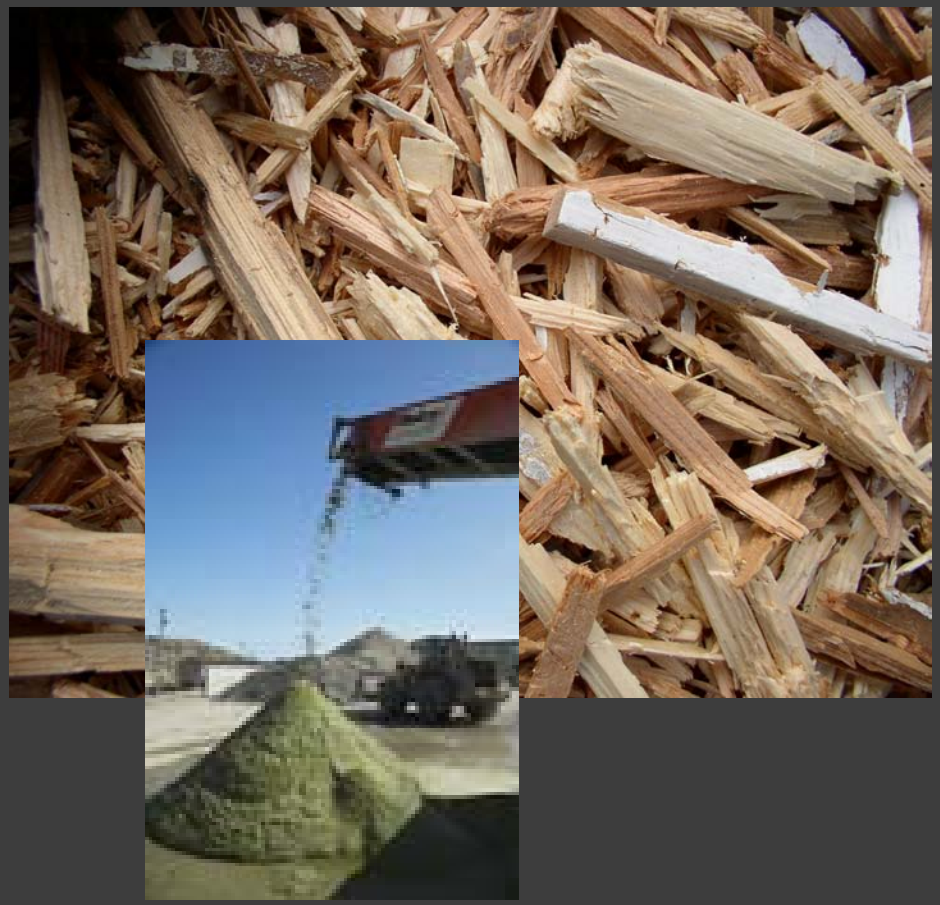
To take these steps, our timber waste streams must be categorised so that the industry can plan and invest wisely, efficiently and practicably. Also there is urgent need to appreciate better the best practicable environmental option (BPEO) for timber waste at the end of its life. The BPEO can be used to assess where best practice can be transferred from one sector to another. BRE and industry are addressing some of these issues through the use of SMARTWaste™, case studies, site visits and interviews with industry. We have classified timber waste, and activities generating that waste, into a simple matrix that has been used to gather information on current activities, best

Definition of waste management options

Reduce Not to generate waste in the first place.
Re-use Re-use in its original form or adjusted to suit a different size; for example, a floor joist used as a floor joist or cut to length as a ceiling joist.
Recycling Recycle into a different form; for example, shredding timber packaging and using as a feedstock for manufacturing chipboard, or composting clean timber.
Recovery Recover energy using thermal processes through incineration, gasification or pyrolysis.
Disposal Dispose of timber in appropriate landfill sites either as hazardous or non-hazardous waste, or combustion without energy recovery.

The work on which this Information Paper is based was funded by the Foundation for the Built Environment

A BRE research project supported by DTI Construction Directorate



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The future now?
The Olympics London 2012

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Sustainable Development

- Carbon
- Water
- Waste
- Materials
- Biodiversity and ecology
- Land, water, noise and air
- Supporting Communities
- Transport and mobility
- Access
- Employment and business
- Health and well-being
- Inclusion

Sustainability

- ODA Sustainable Development Strategy (SDS) targets and commitments with regard to materials are principally based on:
  - *responsible sourcing;*
  - *minimising embodied impacts;*
  - *use of secondary materials; and*
  - *‘healthy’ materials.*

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LONDON
2012

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John F. Yeoman
Rail Pioneer
59206

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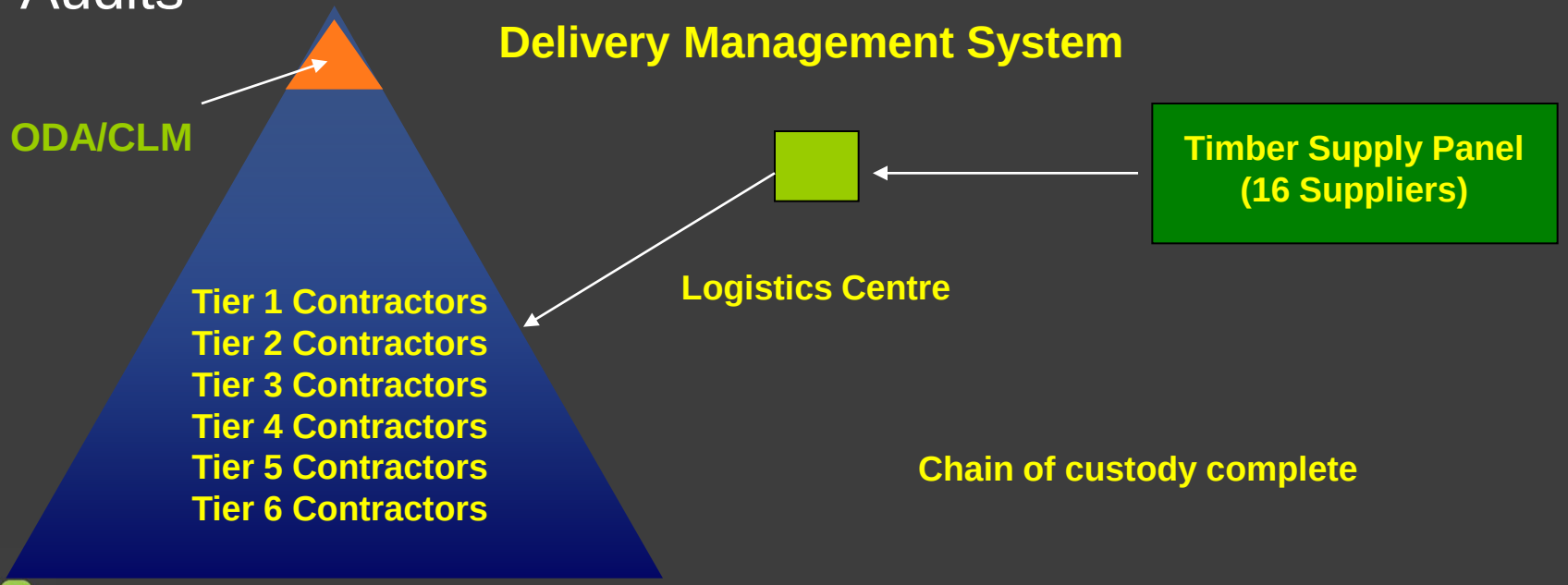
Timber

- ODA Sustainable Development Strategy
- Only Legal and Sustainable timber and wood products (Central Point of Expertise for Timber, CPET)
- Contractual requirement
- ‘Timber panel’
- Audits



Conclusions

- Vital that forest products are a growing part of construction
- Other materials sectors have focussed on improving their sustainability dramatically
- Carbon storage potential is considerable
- Tremendous opportunities
  - Sustainable sourced wood products
  - Products that deliver service life
  - Refurbishment markets are huge and require system innovations
- Step change in carbon and impact measurement

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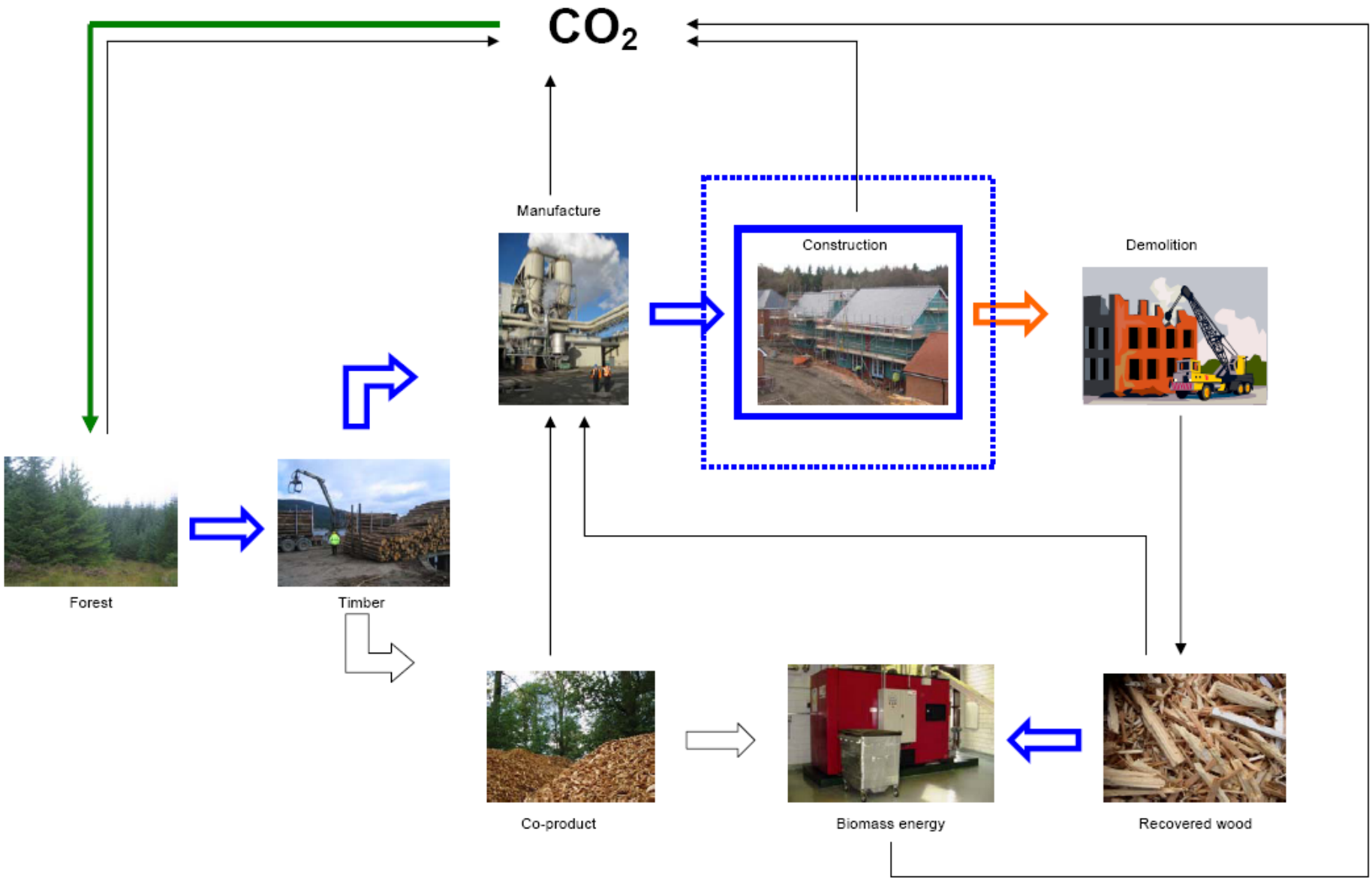
CO_2
Manufacture
Construction
Demolition
Forest
Timber
Co-product
Biomass energy
Recovered wood

Summary

- The tools are there: lever advantage and “credits for clients”
- Give the customers of buildings what they need
  - Major retailers and businesses have climate change programmes
  - Chain of Custody and Responsible Sourcing
- Robust data on LCA and integrating it into ‘the tools’ will make the substitution of materials choice clear
- Increasing the opportunity for timber

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