

NATURALLY HIGH
PERFORMANCE
INSULATION



Mass produced natural construction materials: an opportunity for Europe?

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The ISOBIO project

Development and Demonstration of Highly Insulating Construction Materials from Bio-derived Aggregates

- An overview of the need for sustainability
- Importance of buildings' operational and (increasingly) embodied energy for climate change
- Potential role of renewable plant based materials in construction
- How new techniques (developed by ISOBIO) to increase durability and performance can unlock this potential for widespread use

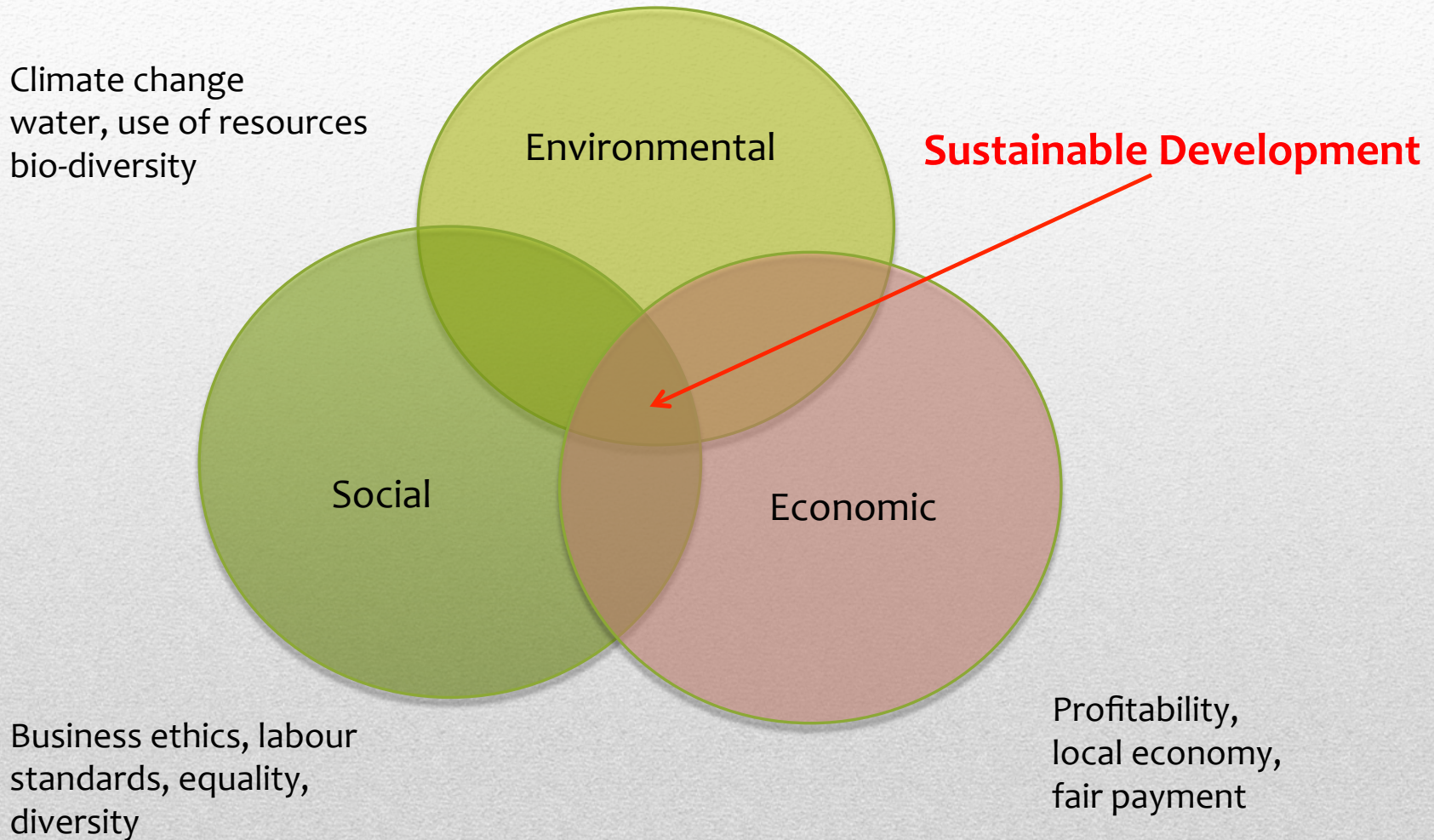
What is sustainability?

- The capacity for continuance
- Bruntland Commission (UNEP 1987):
 - ‘Humanity has the ability to make development sustainable – to ensure that it meets the needs of the present without compromising the ability of future generations to meet their own needs’
- DEFRA
 - ‘A better quality of life for everyone now, and for generations to come’

Sustainable Development

- The process for achieving sustainability
- Corporate Social Responsibility
 - ‘An organisational response to delivering sustainable development’ (Quentin Lieper, ICE President, 2007)
- Balancing environmental, social and economic issues

Balancing Environmental, Social and Economic issues



What does this mean?



Environment

The Earth is a naturally self-sustaining eco-system

This eco-system has been disrupted by human interaction

- Climate change
- Pollution
- Consumption of depleting resources
- Destruction of habitats

What does this mean?



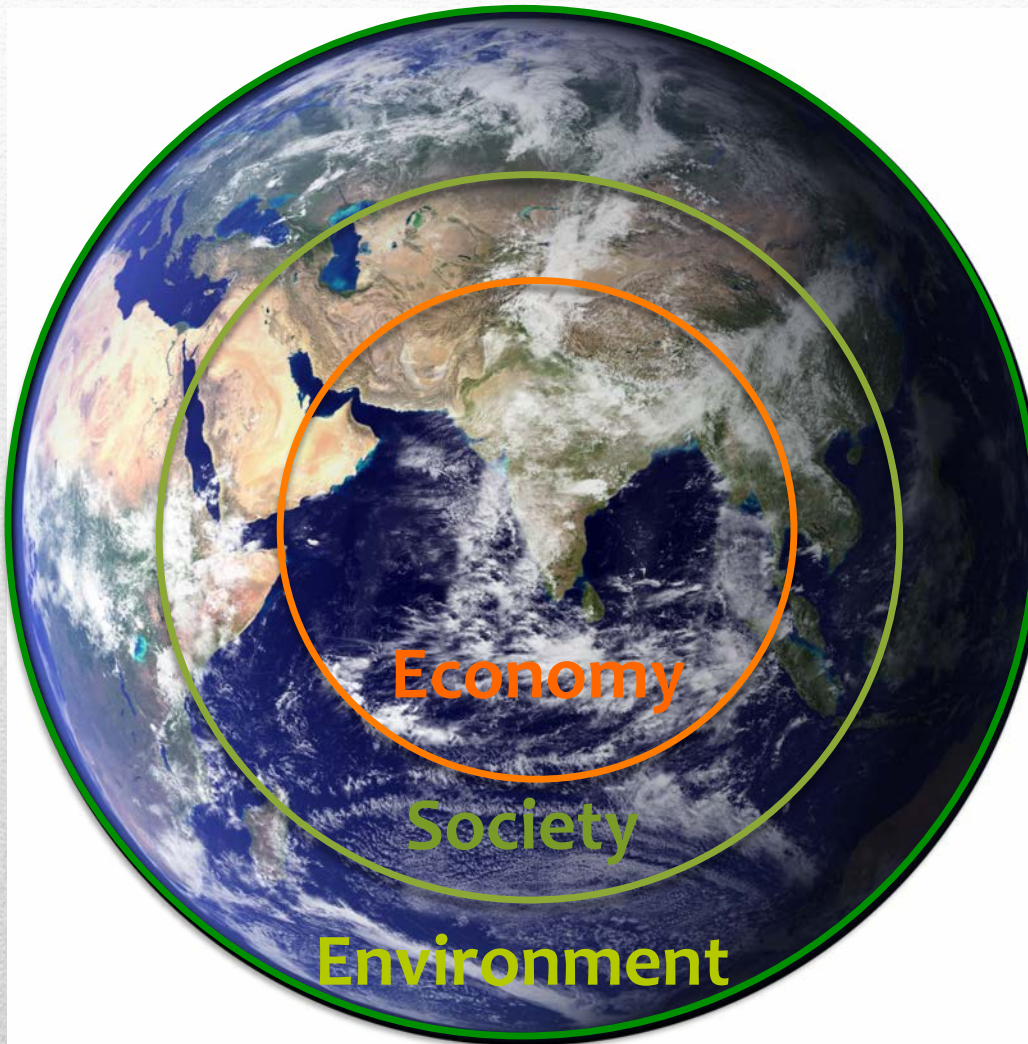
Society

The interface between life forms and the environment

Everyone should be able to share in the benefits of a good quality of life:

- Safe, healthy, clean, diverse environment

What does this mean?



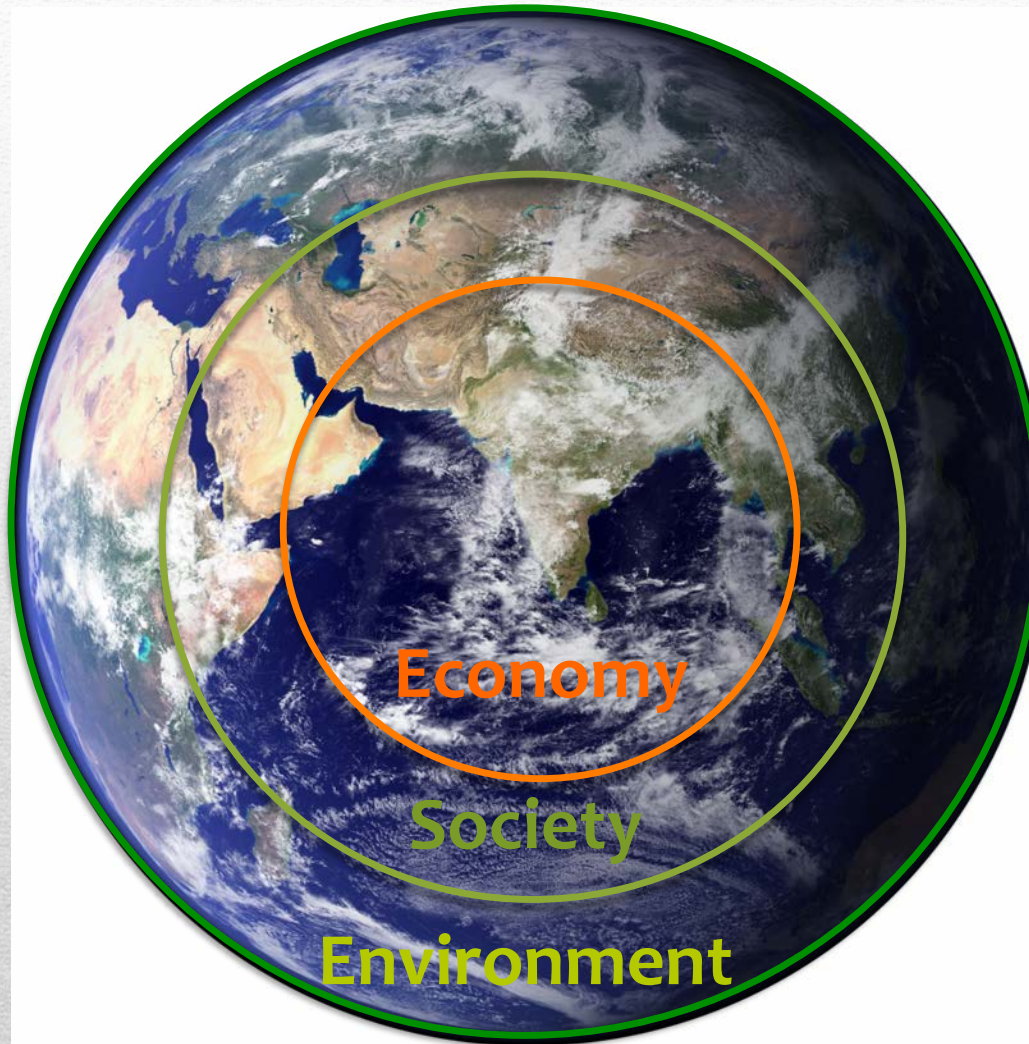
Economy

Society's mechanism for achieving quality of life

Everyone should be able to share in good living standards and job opportunities:

In developed countries this equates to money from jobs to acquire food, clothing, housing
In developing countries this might mean water and sanitation as well as jobs

What does this mean?



These issues are interdependent:

You cannot have an economy without a society to operate it

Society cannot survive without a safe, secure environment

The environment is being threatened by an out of balance economy operated by a society that does not understand the principles of sustainability

What does this mean?

What resources are required for everyone in the world to enjoy the living conditions of the average UK citizen? (World Wildlife Fund, Living Planet Report, 2012)



As we only actually have ONE planet, we must all adapt and reduce our impact

Why is sustainable construction important?

- Construction industry in the UK consumes >400 million tonnes of materials every year
- That's more than 6 tonnes per person per year

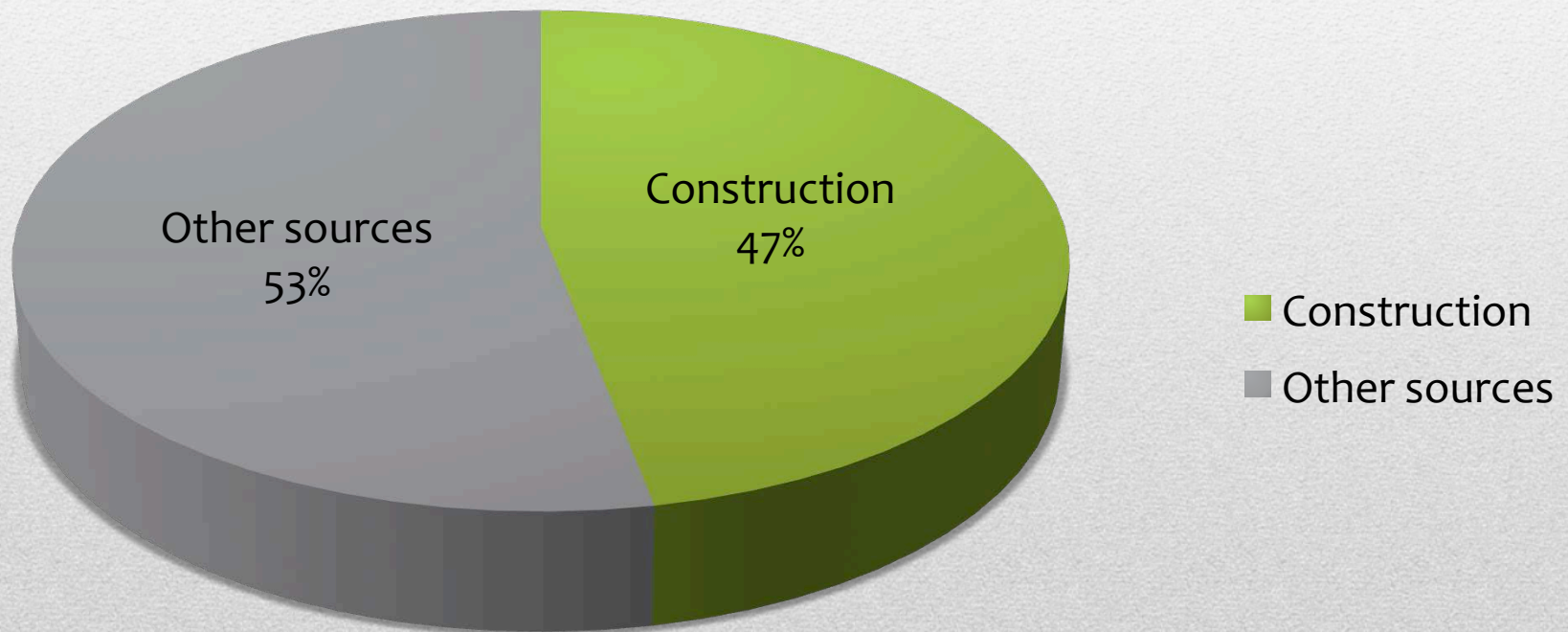


Why is sustainable construction important?

- Construction industry in the UK produces 80 million tonnes of waste every year
- Over 10% (10 million tonnes) is wasted through damage or being surplus to requirements



Total UK CO₂ emissions (2008) 635Mt



Carbon Emissions associated with Construction

1. EMBODIED Emissions

1. The emissions associated with the design, manufacture of components, and construction of the building

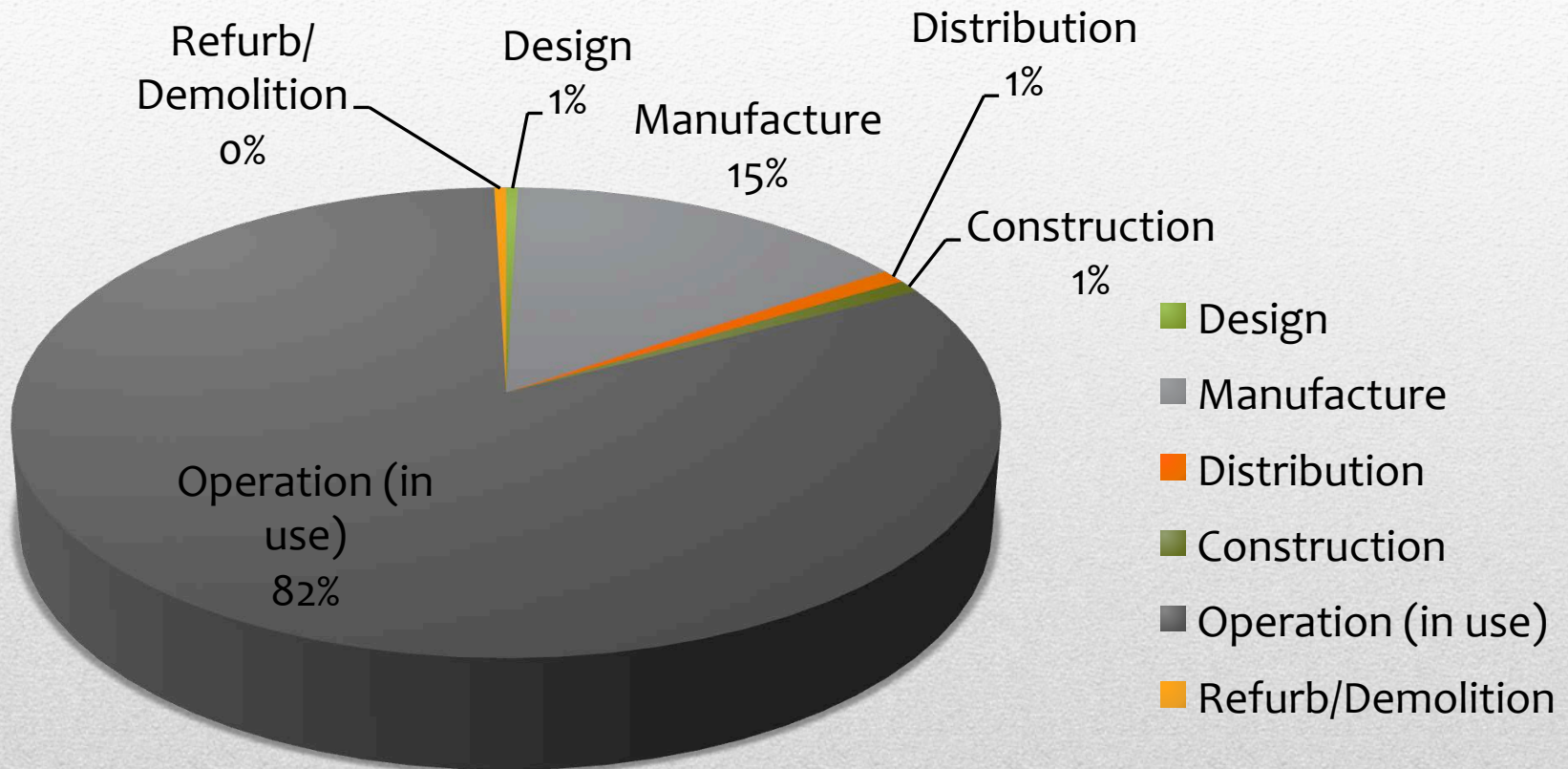
2. OPERATIONAL Emissions

1. The emissions associated with the operation of the building during its lifetime

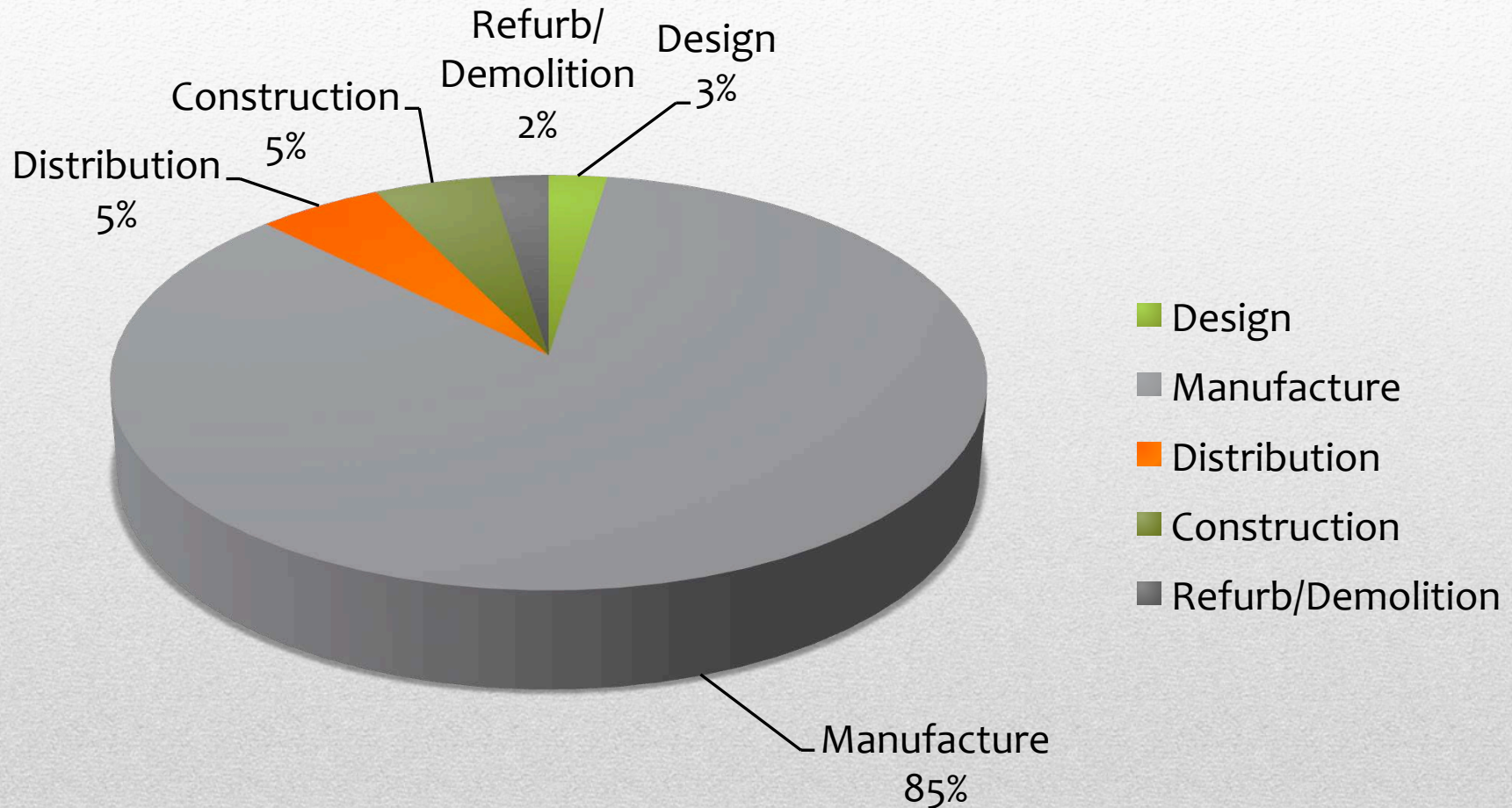
3. END OF LIFE Emissions

1. The emissions associated with refurbishment / demolition of a building

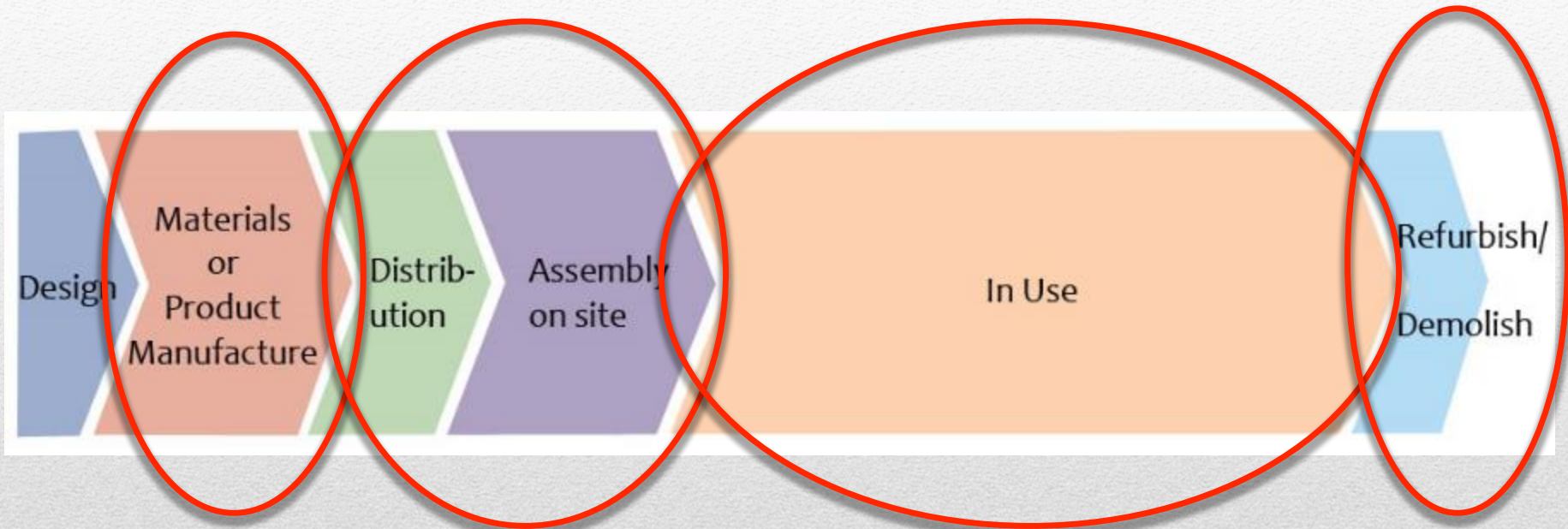
Construction Sector – 289.4 MtCo₂e



Embodied in buildings – 53.2 MtCO₂e



Stages in the life cycle of a building



Use low embodied energy materials
Pre-fabrication, minimise waste

Energy efficient construction systems
Energy efficient design.
Low thermal conductivity, low energy materials and lighting, minimise consumption through passive systems.

Renewable / recyclable materials

The role of natural building materials

- All are sustainable
- Many are renewable (Plant and animal based materials)
- Many SEQUESTER atmospheric CO₂
- Many are recyclable

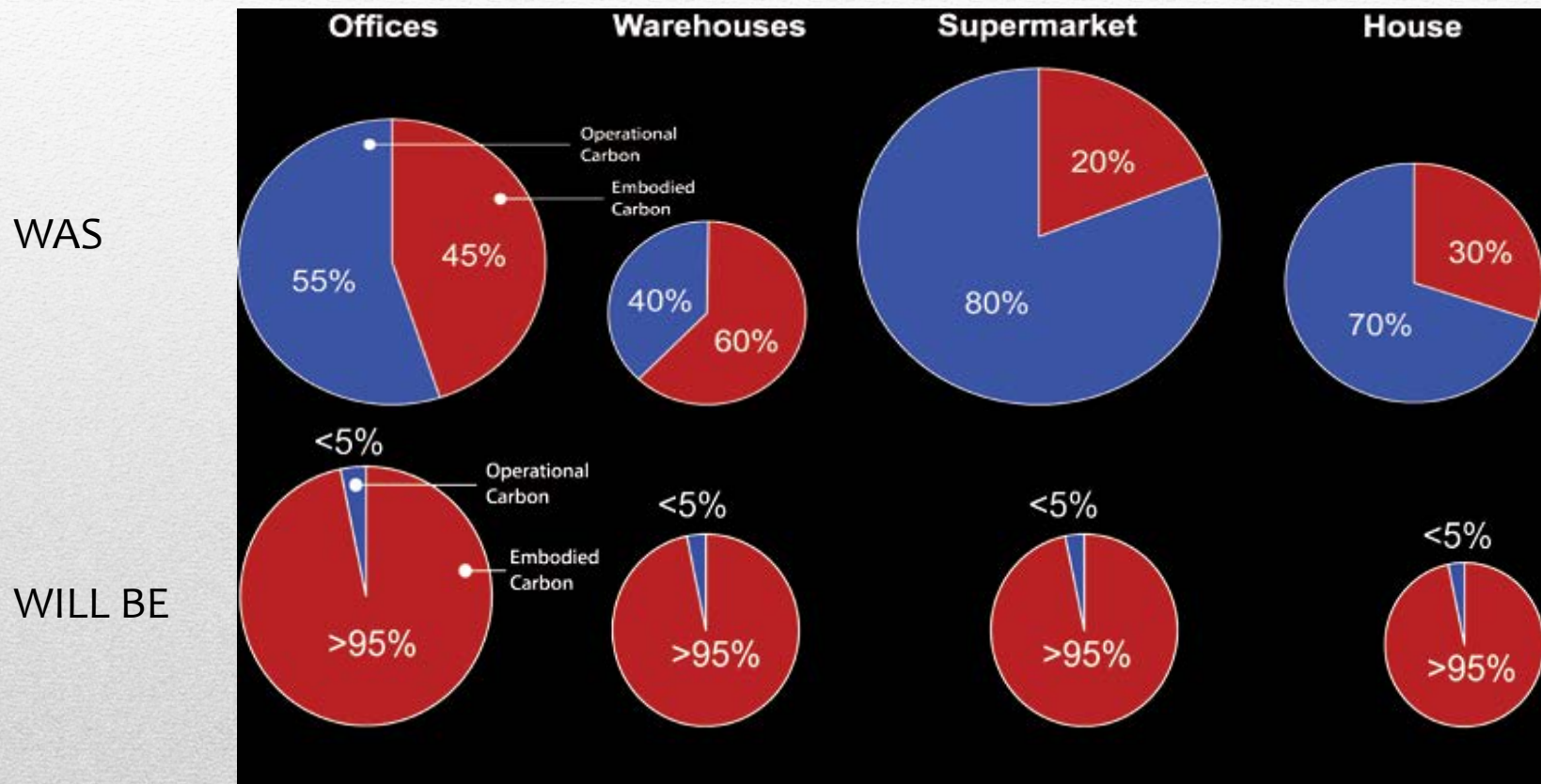
Opportunities for natural materials in modern construction

- Reduced GHG emissions
 - Lower embodied carbon
 - Better environmental performance
- Healthier buildings
- Resource efficiency (renewable; reduced waste)
- New markets (agriculture)

Significance of embodied carbon

- Cement production currently contributes around 5% global industrial CO₂ emissions (around 1.3bn tonnes p.a.).
- By 2050 cement based CO₂ emissions projected to rise to 2.5 - 5bn tonnes p.a..

Embodied Carbon and Operational Carbon



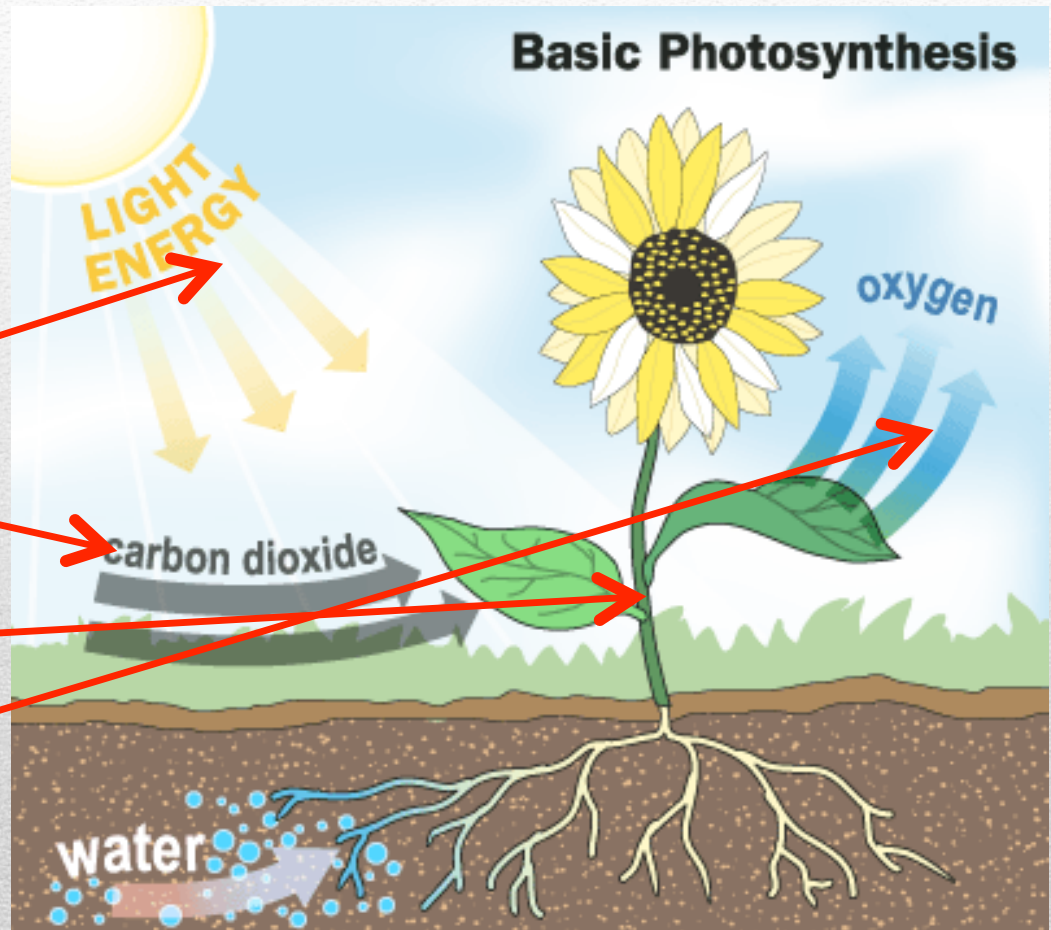
Ref. Sturgis Associates – Indicative whole life carbon emissions

Carbon footprint

- Hemp-lime **stores** around **110 kg.CO₂/m³** (33 kg.CO₂/m² for a 300 mm thick wall)
- Straw bale **stores** around **145 kg.CO₂/m³** (70 kg.CO₂/m² for a 490 mm thick wall)
- Masonry **emits** around **110 kg.CO₂/m²** for an external cavity wall

Biogenic Carbon

- Photosynthesis
- Plants absorb CO_2
- The CO_2 becomes part of the plant
- Stores C, emits O_2
- Called biogenic carbon (storage)



Timber

- Part of the mass of timber is carbon (C)
- Which has been sequestered from the atmosphere
- This can be included as a carbon storage benefit
- Also called carbon sequestration
- Is a benefit if sustainable timber
- So how much CO₂ is locked up in timber?



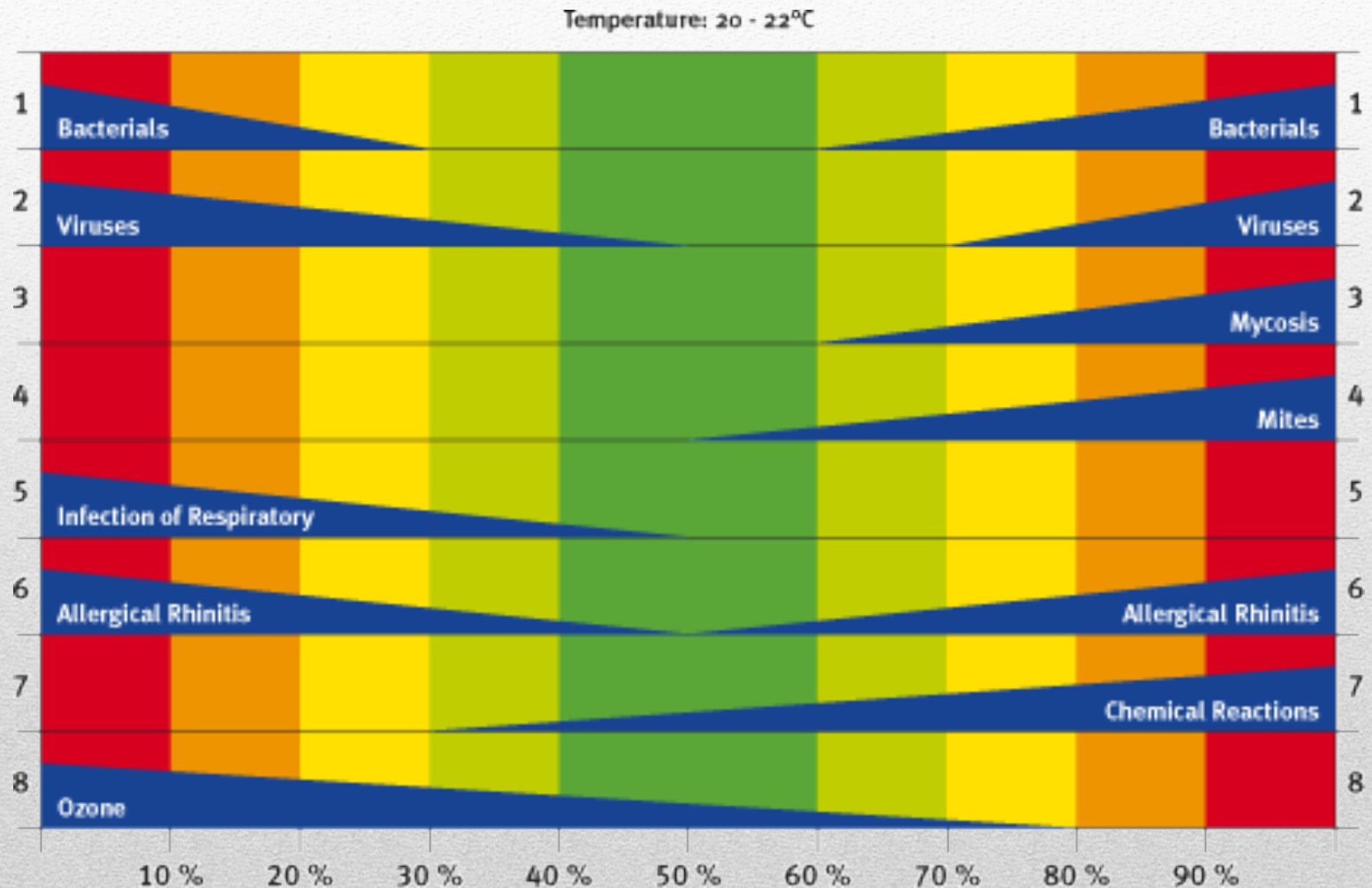
Carbon Storage

- How many kg of CO₂ is absorbed to make 1 kg C?
- Use molecular weights
 - C = 12
 - O = 16
- CO₂ therefore = 44
- Compare C (12) with CO₂ (44)
- $44 / 12 = 3.66667$
- **1 kg C in wood is created by 3.67 kg of CO₂ from the atmosphere**

Building Health

- Breathing walls
- Triggers for **asthma** include moulds and high microbial levels linked to high humidity levels in buildings
- **Sick Building Syndrome** (headaches, breathing difficulties, skin problems) is linked to airborne and chemical pollutants, fungal spores, poor ventilation....
- **Reduced internal humidity and airborne chemicals reported using natural materials**

Building Health



The ISOBIO project

Development and Demonstration of Highly Insulating Construction Materials from Bio-derived Aggregates

- Novel approach to bio-based construction
 - Bio-based aggregate
 - Bio-based binders
 - Novel plasters and renders
 - Treatments to reduce fire risk; resist bio-decay
 - Pre-fabricated system – zero defect, minimise waste

The ISOBIO project

Major Achievements

- ISOBIO rigid panel
 - Insulating external render
 - Insulating clay plaster
 - Hygrophobic, fire resistant treatments
 - Pre-fabricated panelised system
- ALL have the potential for high volume mass production



The consortium

Multidisciplinary consortium of 11 partners from 6 different European countries.



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