



Embodied Carbon in Buildings and Materials AECB 2011 Conference

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Setting the Landscape Contents

- Introducing Sustain
- Political Context
- Introducing Carbon Footprinting
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Embodied Carbon

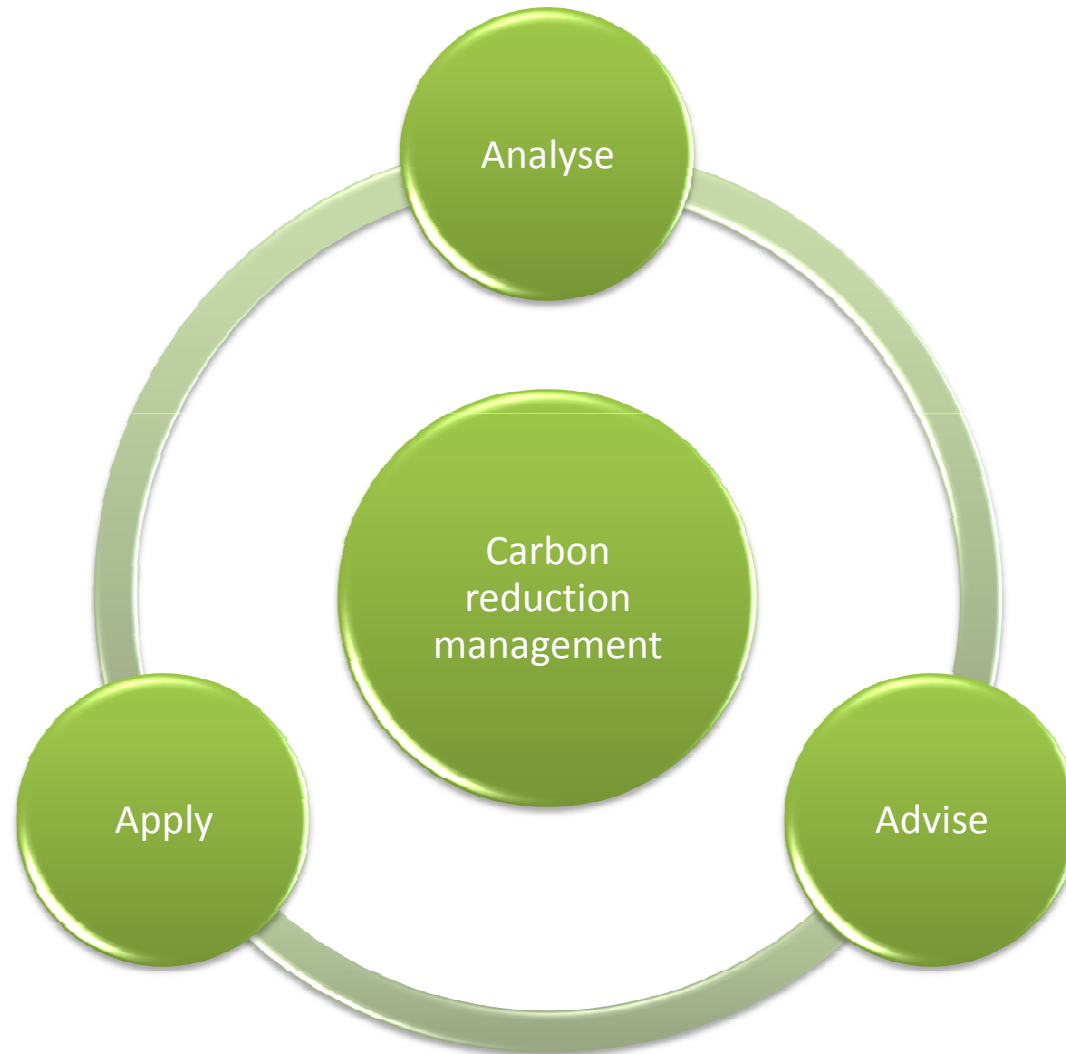
Introducing Sustain



About Sustain



The Client Journey



Real Results with our Clients

4,231,460 tonnes of CO₂e

Lifetime carbon savings with our clients, as of
July 2011

Environmental Accounting



Get a Quote >>>
See how much you could save



Setting the Landscape

Political Context



Sustainable Development

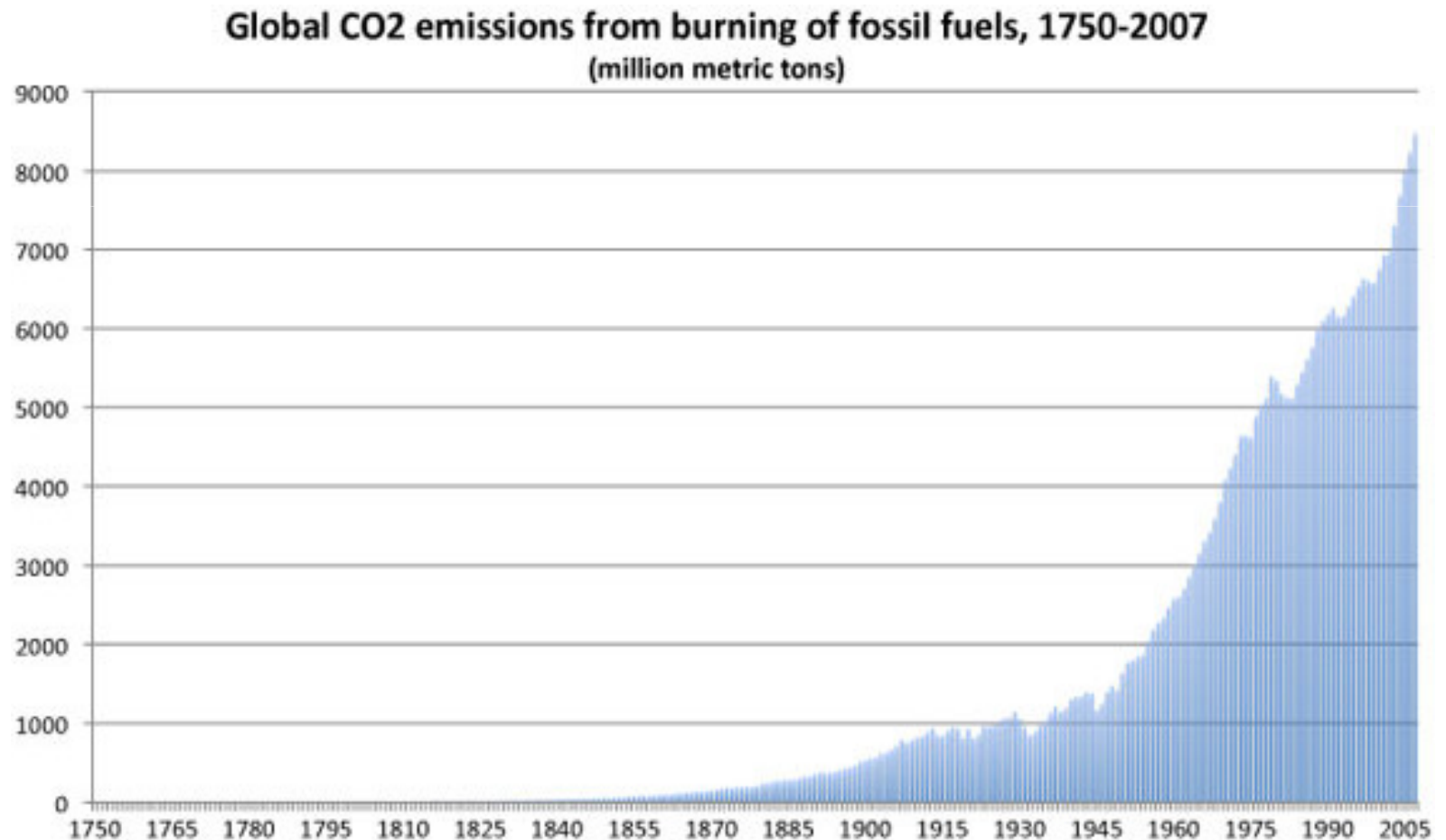
There are over 200 definitions of sustainability –
Sara Parkins, 2000

***“Meeting the needs of the present without
compromising the ability of future
generations to meet their own needs”***

Brundtland Report, 1987

Worldwide CO₂ Emissions - Total

- Worldwide GHG emissions rapidly rising



Political Context

International CO₂ emissions progress

Region	1990-2008 CO ₂ emissions	Kyoto Target
World emissions	+40.1%	-
Kyoto parties with a target	-9.2%	-4.7%
Europe	+2.2%	
North America (Canada)	+27%	
Pacific	+17%	
<i>Economies in transition</i>	-32%	

- Worldwide emissions have increased significantly
- Kyoto parties with targets have reduced CO₂
- But only because of **significant reductions from “economies in transition”**, e.g. Czech, Hungary, Poland, Russia, Ukraine

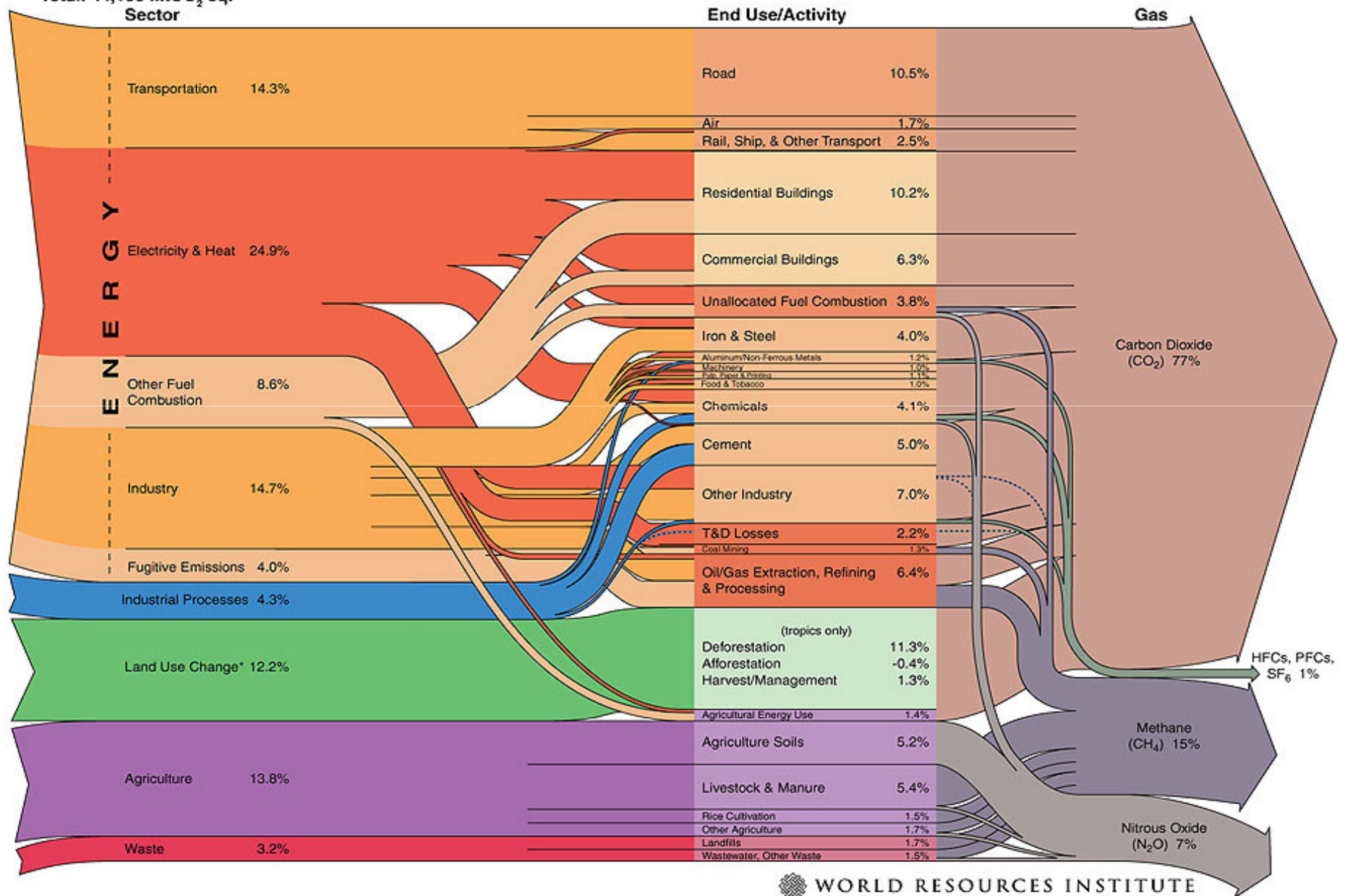


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CO₂ equivalents (CO₂e)

GHG	100 year GWP Factor	Typical sources
CO ₂	1	Energy combustion, chemical/biochemical reactions
CH ₄	25	Decomposition
N ₂ O	298	Fertilisers, car emissions, manufacturing
SF ₆	22,800	Switchgears, sub-stations
PFC	7,390 – 12,200	Aluminium smelting
HFC	124 – 14,800	Refrigerants, industrial gases

World Greenhouse Gas Emissions in 2005
Total: 44,153 MtCO₂ eq.



Embodied Carbon

Introducing Carbon Footprinting & Embodied Carbon



What is a carbon footprint?

- A Carbon Footprint is a component of an ecological footprint (See figure)
- It's a spatial indicator - Ha
- However for materials often...
- 'Carbon Footprint' = **Embodied Carbon**
- Embodied Carbon - 2 components
 1. (Fossil) Fuel-Related Carbon – Typically most significant
 2. Non-Fuel Related Carbon
- We must therefore start with Energy....
- **Embodied Energy**....

Embodied Energy (EE) & Embodied Carbon (EC)

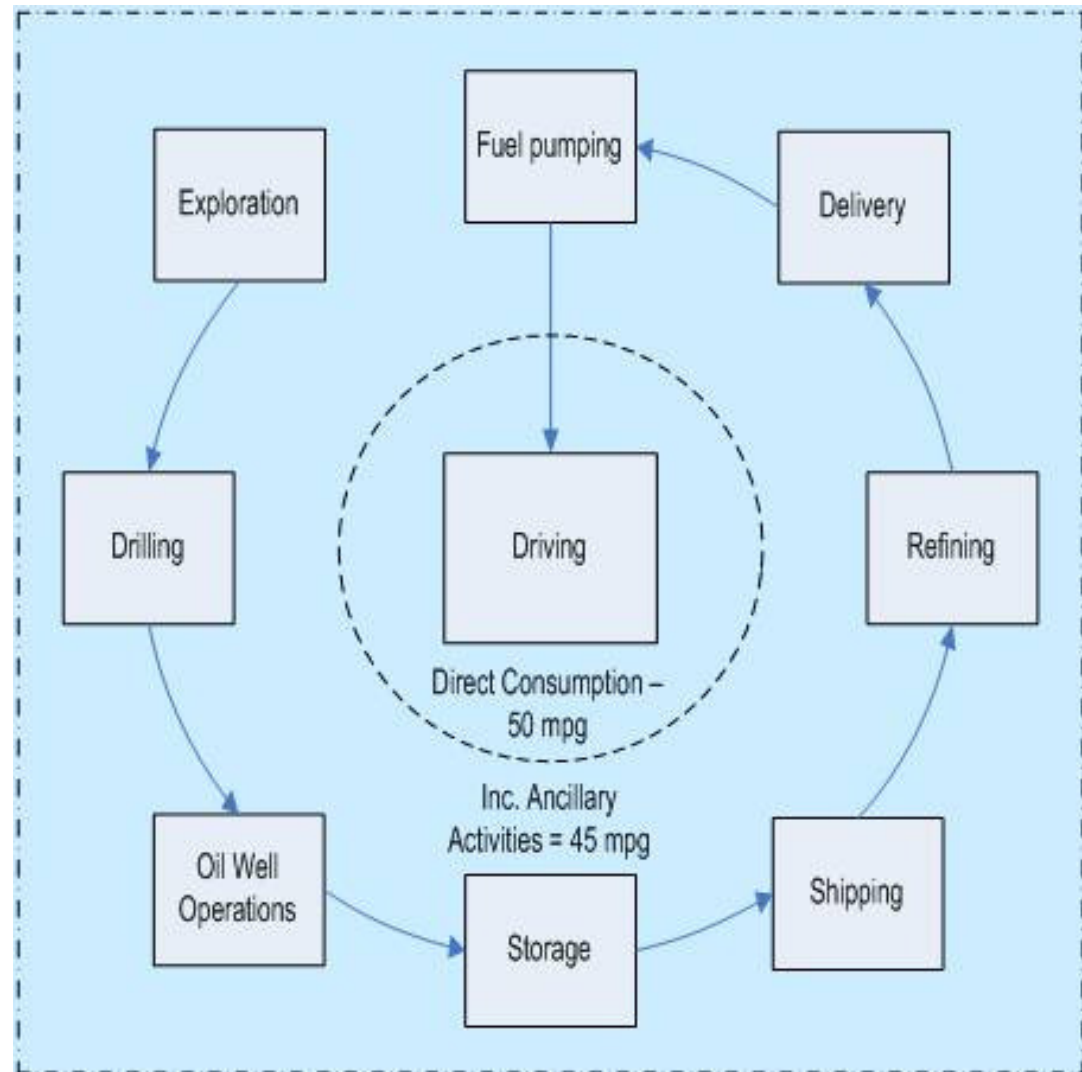
Embodied Energy (Carbon) may be taken as...

...the primary energy consumed (carbon released) to extract, process, transport, and fabricate a product (or activity).

This ideally includes all direct and indirect energy & carbon sources associated to the product i.e. all energy **flows must be traced upstream...**

Life Cycle Thinking Tracing Impacts Upstream

- e.g. driving a car
- Fuel economy = 50 mpg
-but this is only the direct fuel consumption!!
- Supporting activities = extra indirect impacts

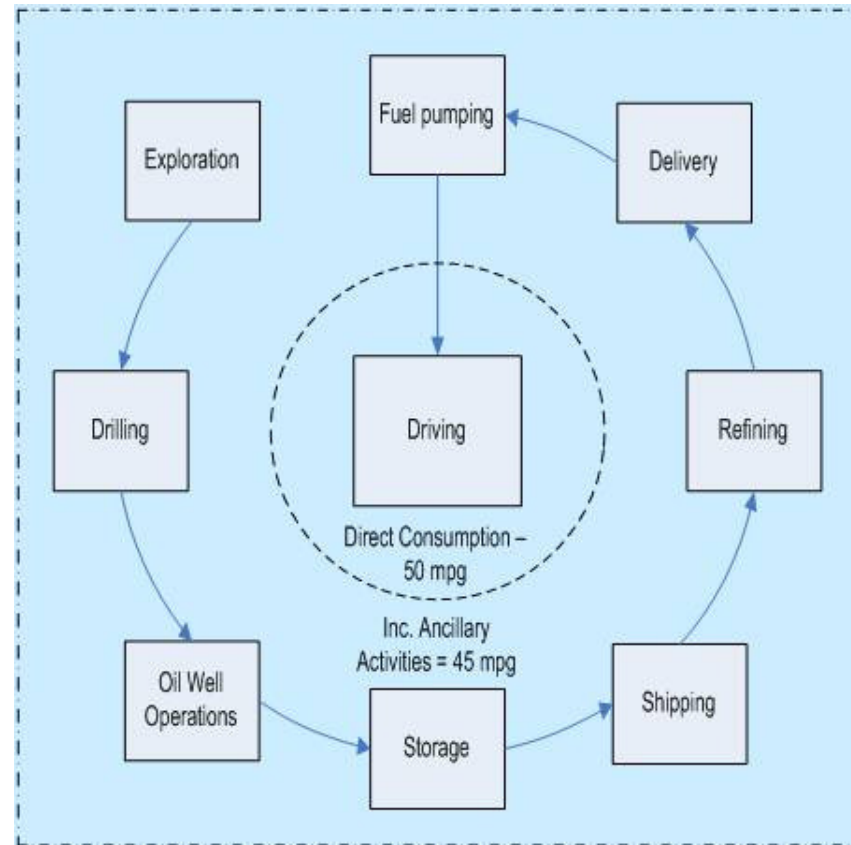


Upstream Burdens



Life Cycle Thinking Tracing Impacts Upstream

- e.g. driving a car
- Fuel economy = 50 mpg
-but this is only the direct fuel consumption!
- Ancillary activities = extra indirect impacts



Real fuel economy = 45 mpg

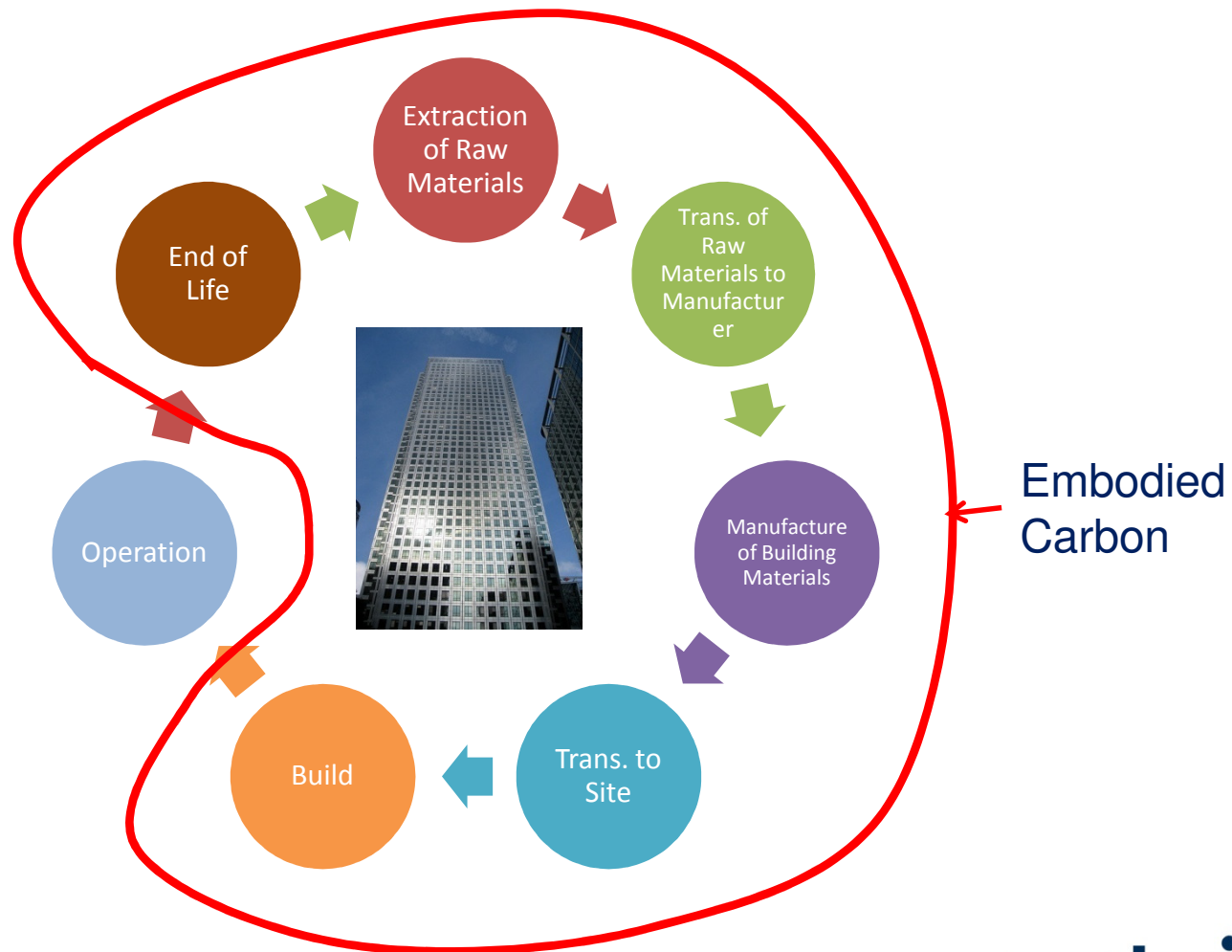
A Life Cycle Perspective

The Life Cycle of a Building



A Life Cycle Perspective

The Life Cycle of a Building



Setting the Landscape

Landscape Overview: Key Activities and Standards



Landscape Overview

- HM Government Report Published in Autumn 2010
 - Low Carbon Construction - Innovation & Growth Team (IGT)
 - Paul Morrell, Chief Government Advisor for Construction, chaired the group
 - Two recommendations on embodied carbon...

Landscape Overview

Recommendation 2.1 That as soon as a sufficiently rigorous assessment system is in place, the **Treasury should introduce into the Green Book a requirement to conduct a whole life (embodied + operational) carbon appraisal** and that this is factored into feasibility studies on the basis of a realistic price for carbon.

Recommendation 2.2 That the industry should agree with government **a standard method of measuring embodied carbon** for use as a design tool and (as Recommendation 2.1 above) for the purposes of scheme appraisal



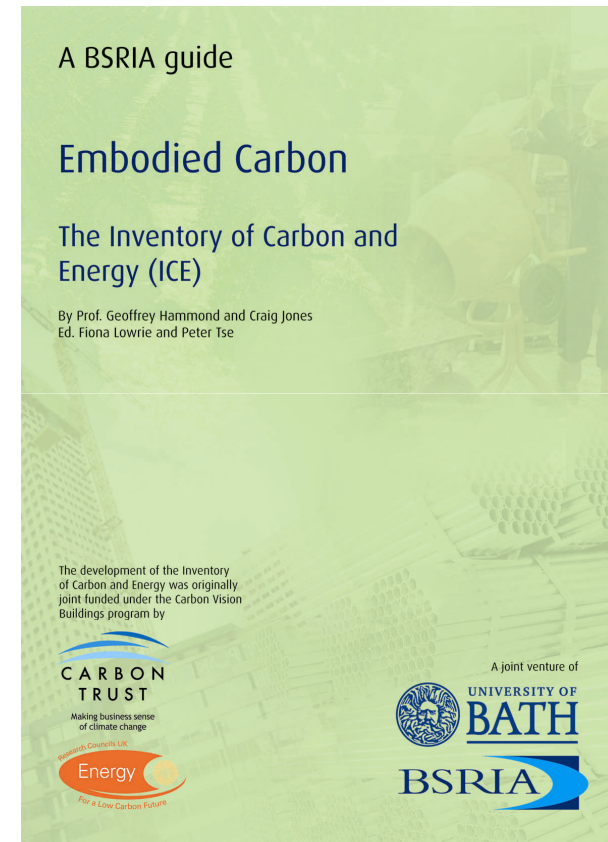
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Landscape Overview

- **ICE:** civil engineering standard method of measurement - CESMM3
 - Price book for project costing – civil eng.
 - Now contains Embodied Carbon
- **Hutchins:** Blackbook, construction costs
 - Similar to above, cost book – building
 - Now includes Embodied Carbon
- **IStructE:** publishing a guide on embodied carbon
- **CIRIA** and **CIBSE**

The Inventory of Carbon & Energy (ICE)

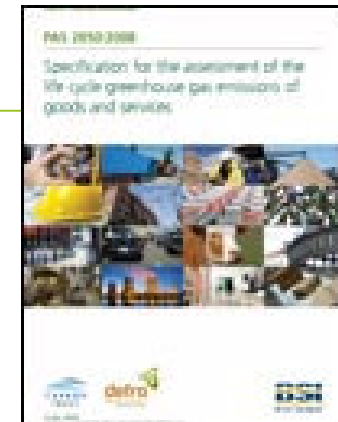
- An **embodied energy and carbon database** for building materials
- Primarily for Construction Materials
- Data for over 200 materials
- Over 11,000 worldwide users
- BSRIA hardcopy published in January 2011



Standards – Current & Emerging

- **PAS 2050** (*current, revision expected 2011*)
- **PAS 2060** (*current*) – Carbon neutrality
- **WRI/WBCSD GHG Protocol** –Product Life Cycle Accounting and Reporting Standard (*2011*)
- **** CEN TC/350 for Construction **** (*2011/12*) – Sustainability assessment of construction works
- **ISO 14067** (*2012*) – Carbon footprinting
- **French Environmental Label** – A national initiative (*2011/12*)

PAS 2050



- Developed by BSI and co-sponsored by the Carbon Trust and Defra
- Methodological basis for product and service carbon footprints
- Detailed assessment requiring considerable amounts of primary data
 - Upstream suppliers regularly require primary data
 - Factory energy consumption, purchased materials, waste...etc

Streamlined Product Carbon Footprinting

Sustain's QuickSteps™

- **PAS 2050 is a detailed assessment** which offers accurate results
 - However it requires appropriate **resources**
- It's **not within the resources** of all companies wanting to invest in product carbon footprinting
 - e.g. SMEs
- Sustain's **QuickSteps™** - Streamlined **product carbon footprints** offer a **cost effective solution**
 - **Robust methods** combined with **streamlined data collection**
 - Provides a **product specific footprint** in a lower cost solution


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CEN TC 350 - Sustainability of Construction Works - Assessment of Buildings

- Emerging European standards on the “**Sustainability assessment of construction works**” – *late 2011 onwards*
 - **Environmental, economic and social** performance
- Widely expected to be **influential in construction**
- There will be pressures on material manufacturers for **certification of products** – product carbon footprinting
- A product carbon footprint, i.e. QuickSteps, PAS 2050, could be used as a **precursor to future certification**

Sustainable Procurement

Title: **“BS 8903:2010**

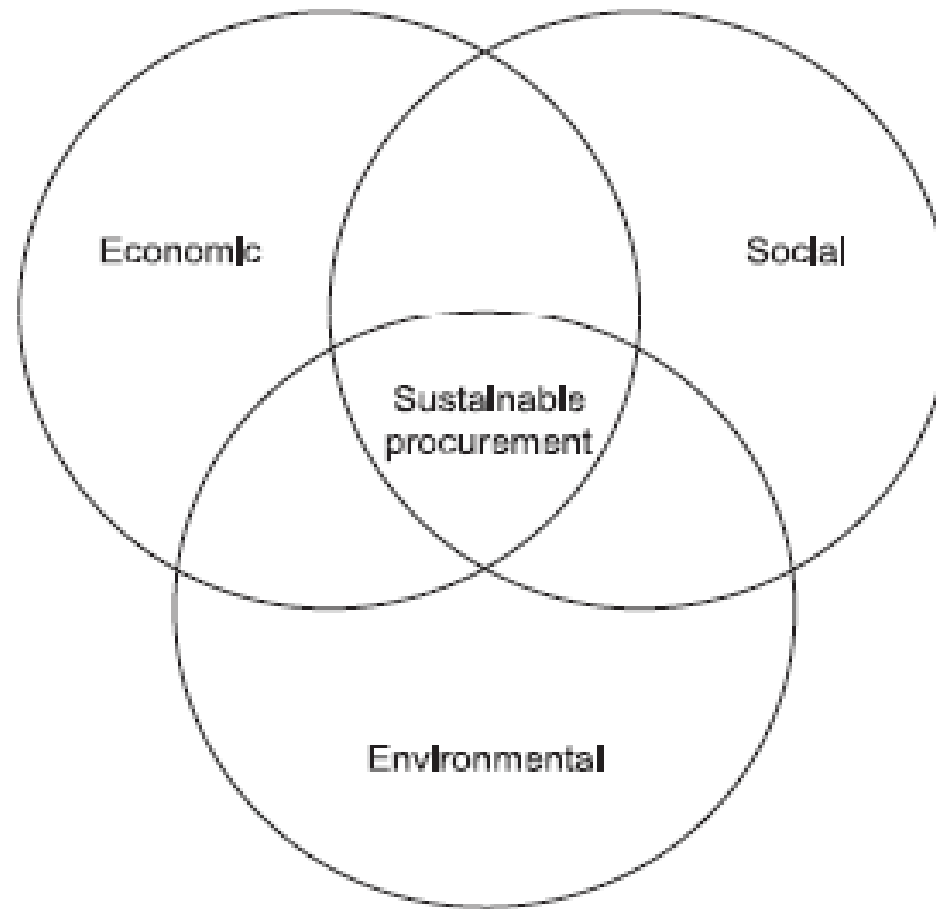
**Principles and framework for procuring
sustainably – Guide”**

“BS 8903 is a ‘daughter’ standard of BS 8900,
which defines sustainable development as:
An enduring, balanced approach to economic
activity, environmental responsibility and
social progress.”

What is Sustainable Procurement?

Procuring sustainably allows organizations to meet their needs for ***goods, services, works and utilities*** in a way that achieves value for money on a ***whole life basis*** in terms of ***generating benefits*** not only to the organization, but also to society and the economy, ***whilst minimizing damage to the environment.***

Balancing Sustainable Procurement Objectives



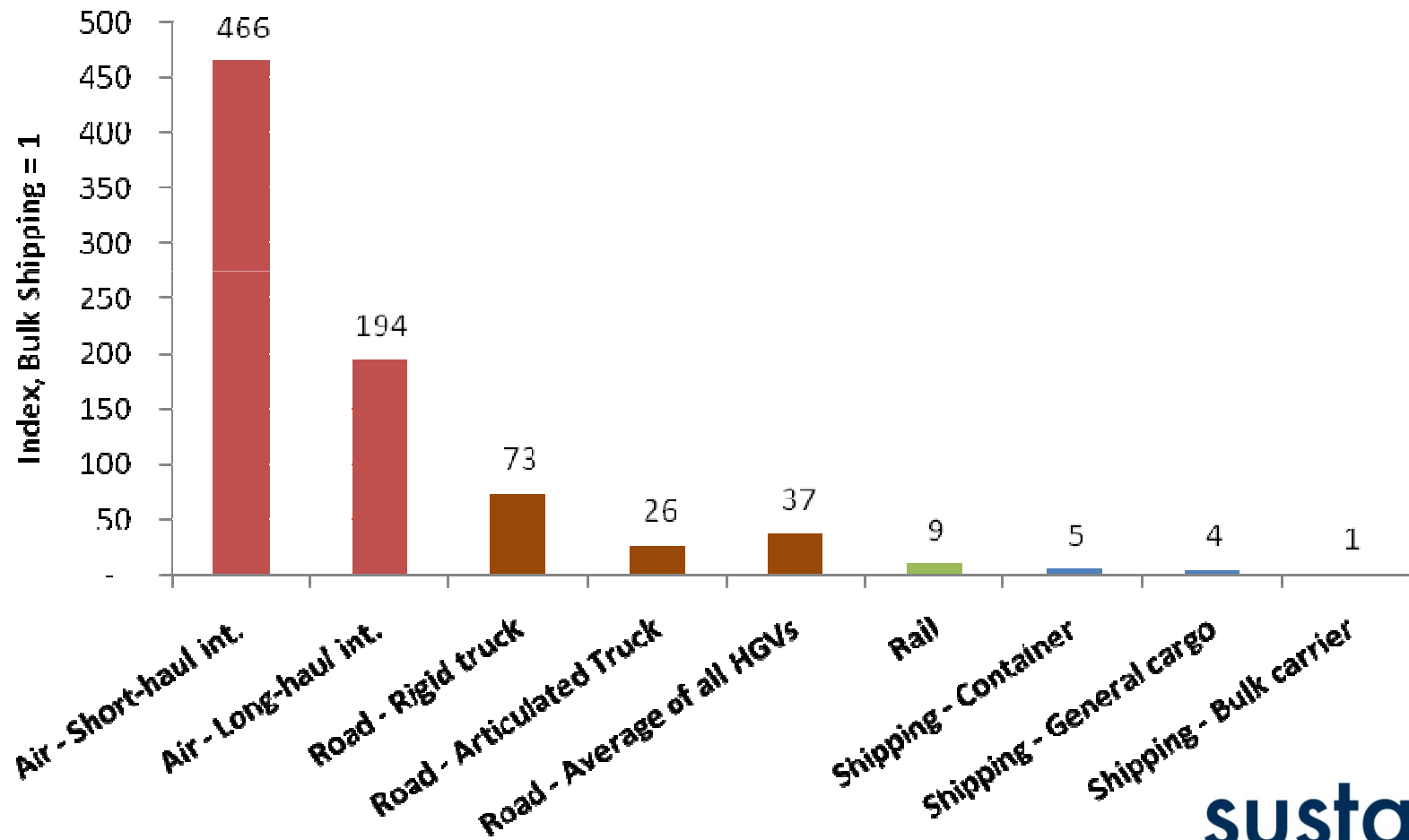
Greening Supply Chains

- Many organisations are starting to realise that the **largest share of their GHG impacts** are coming from their **upstream supply chains**
 - e.g. NHS, BT, Tesco's, Walmart, Anglian Water
- Embodied carbon of **procurement is significant**
- Transport is not typically a major contributor for a whole building project
 - Naturally there are many exceptions
 - Sensible transport strategies are more important, especially for certain materials

Greening Supply Chains

Sensible Transport Strategies

Carbon Emissions per Tonne.km for Transport



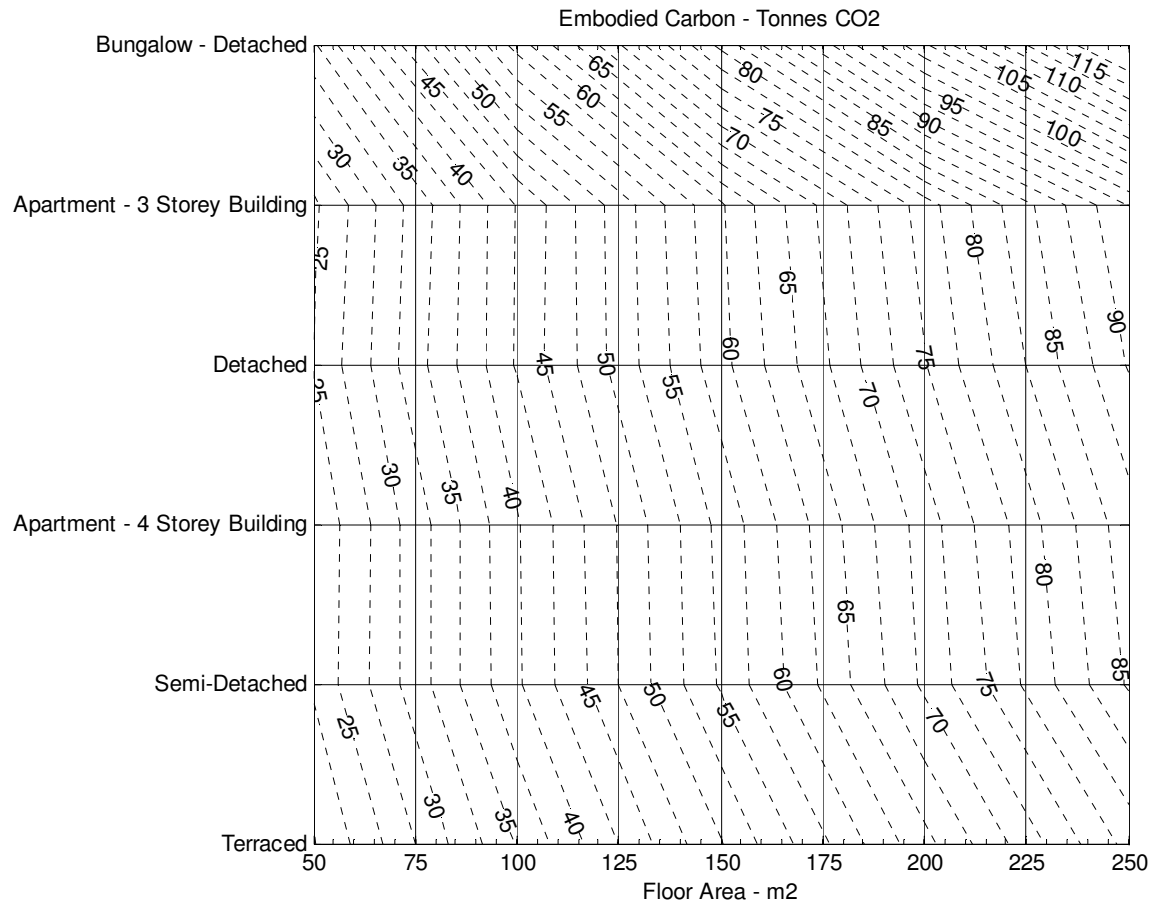
Setting the Landscape

Whole Life Carbon: Projecting the Future



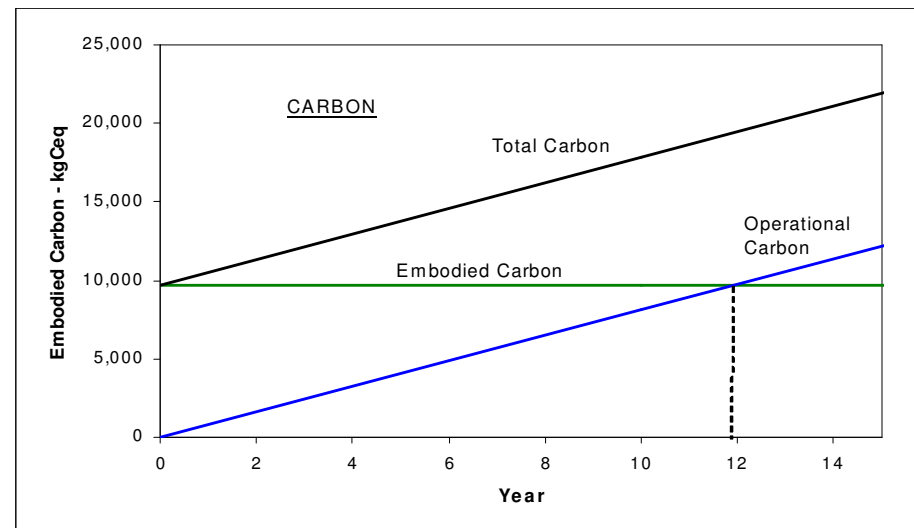
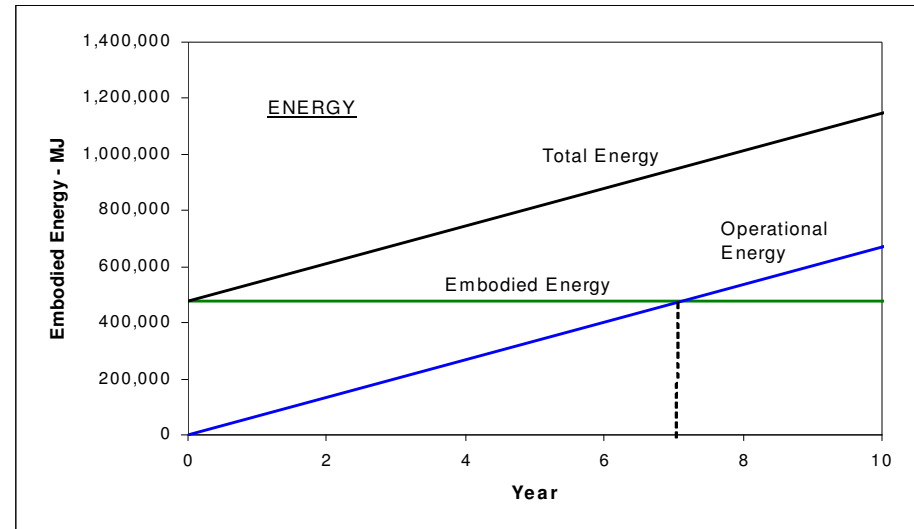

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Benchmarks – Embodied Carbon in Domestic Buildings



Embodied V Operational Energy

- Average UK House – 83 Sqm
- Embodied: 480 GJ & 36 tonnes CO2
- 2006 Building Regulations operational energy and carbon
- Energy = 7 yrs
- Carbon = 12 yrs
- Upgraded Specification
 - Energy = 11.5 yrs
 - Carbon = 19 yrs



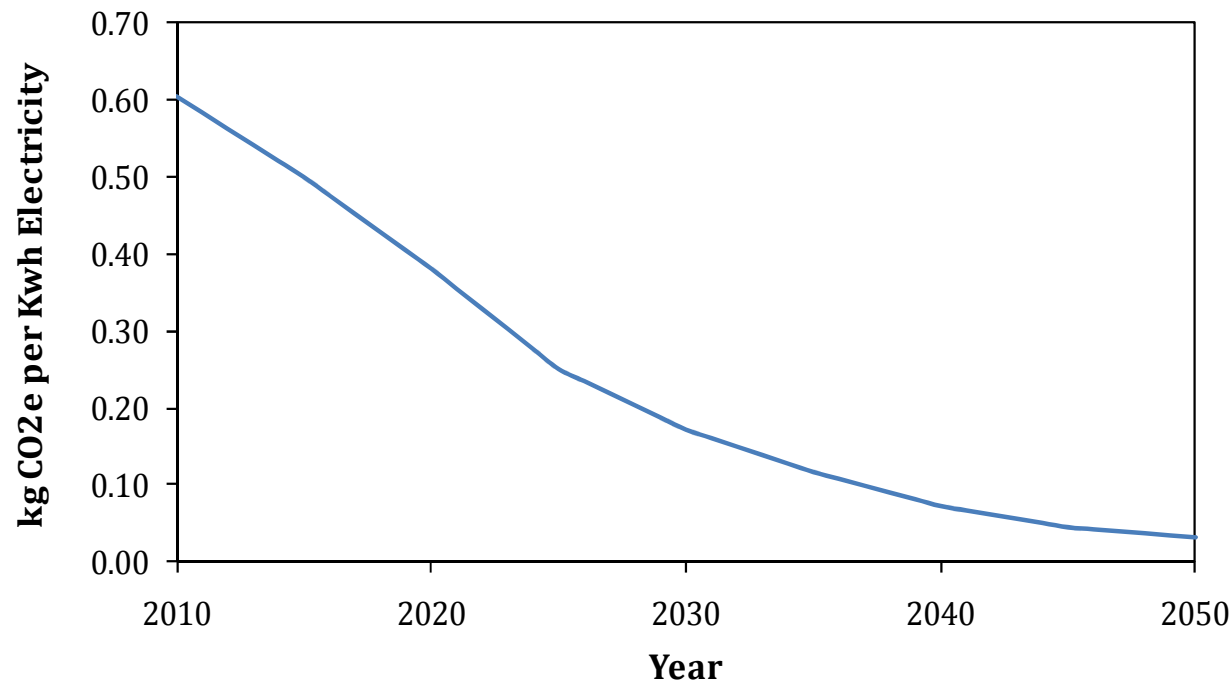
Future Emission Reduction

- The UK is legally committed to an **80% reduction in GHG** emissions 1990-2050
 - with a 34% reduction by 2020
- These are highly ambitious and will require **strong action from all sectors**
- The **electricity sector** is expected to have an almost **complete decarbonisation**
- It's a **centralised** system which makes it easier to target
- Buildings consume **large amounts of electricity**

Future Electricity Emissions

- Based on a DECC future electricity model
- In 2050 a unit of electricity will be 95% lower carbon

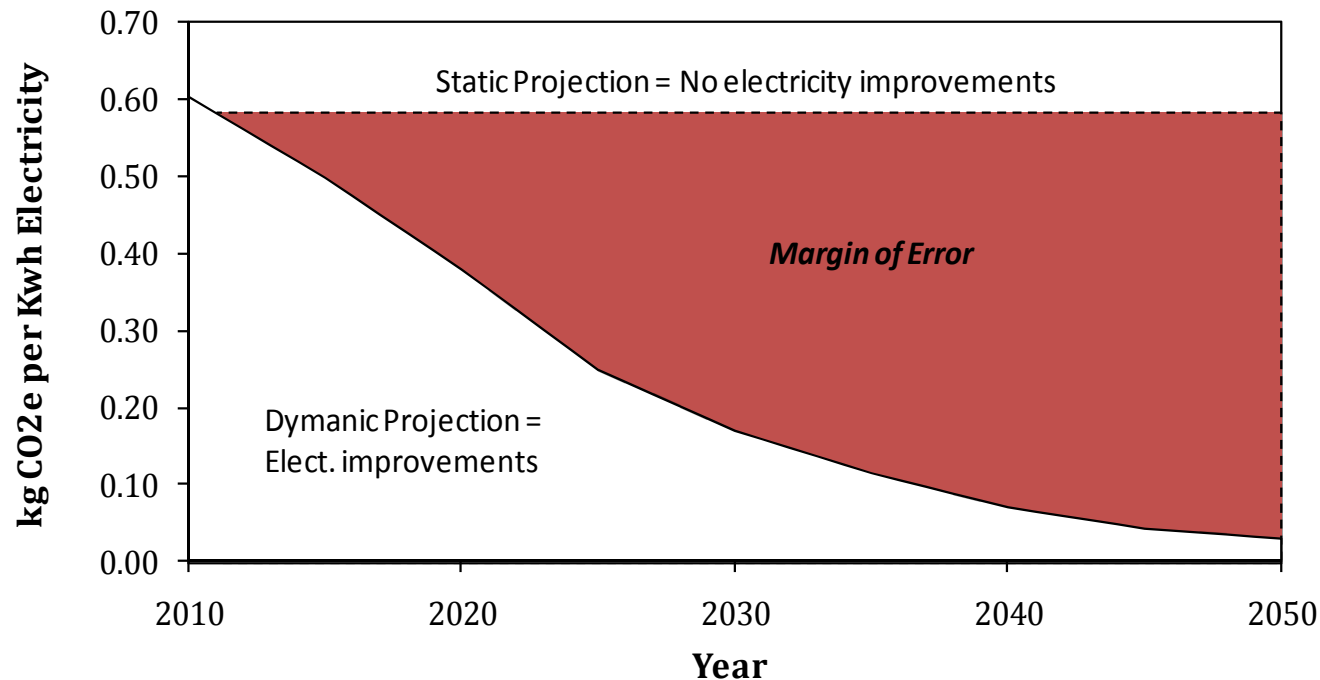
GHG Intensity of UK Electricity, 2010-2050



What does this mean for whole life carbon?

- Current models of whole life carbon are projecting based on today's emissions factors for electricity
- This gives **270% more emissions** than a dynamic view

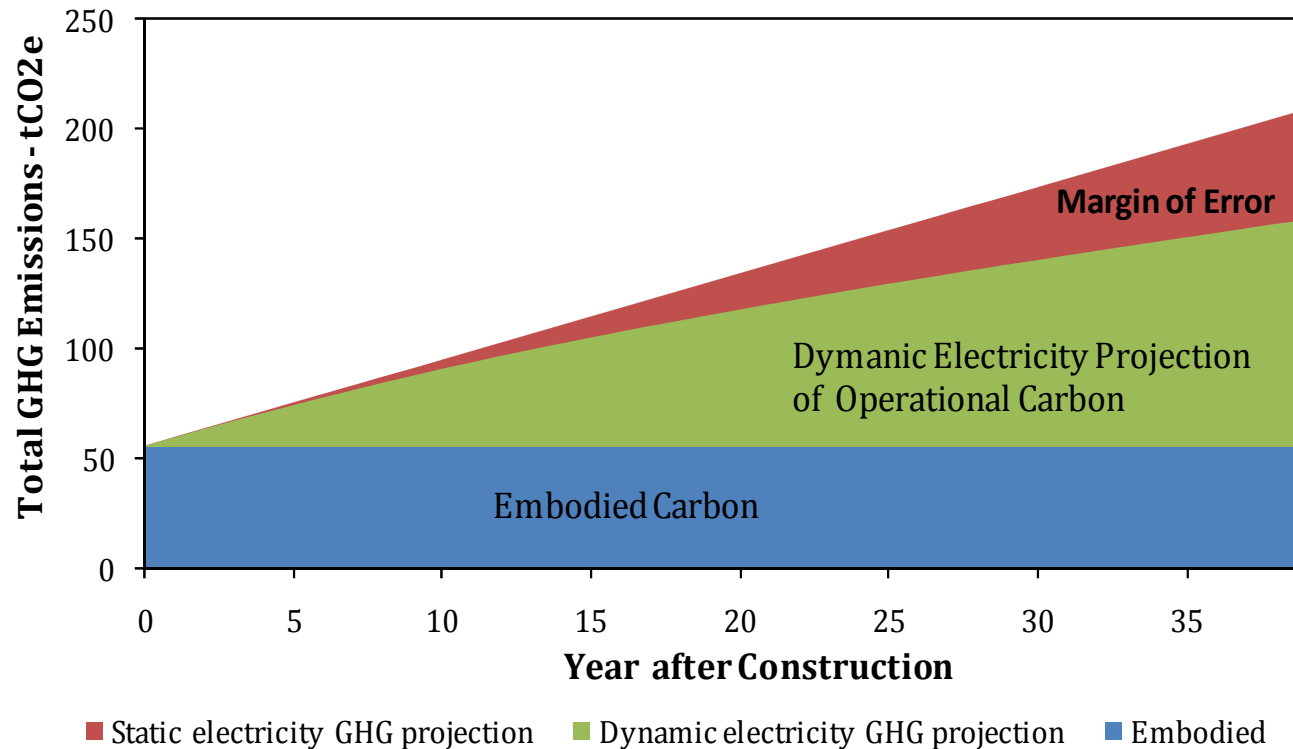
Static V Dymanic Projection of UK Electricity



Case Study: A House

- A static projection **overestimates** operational emissions by **50%**

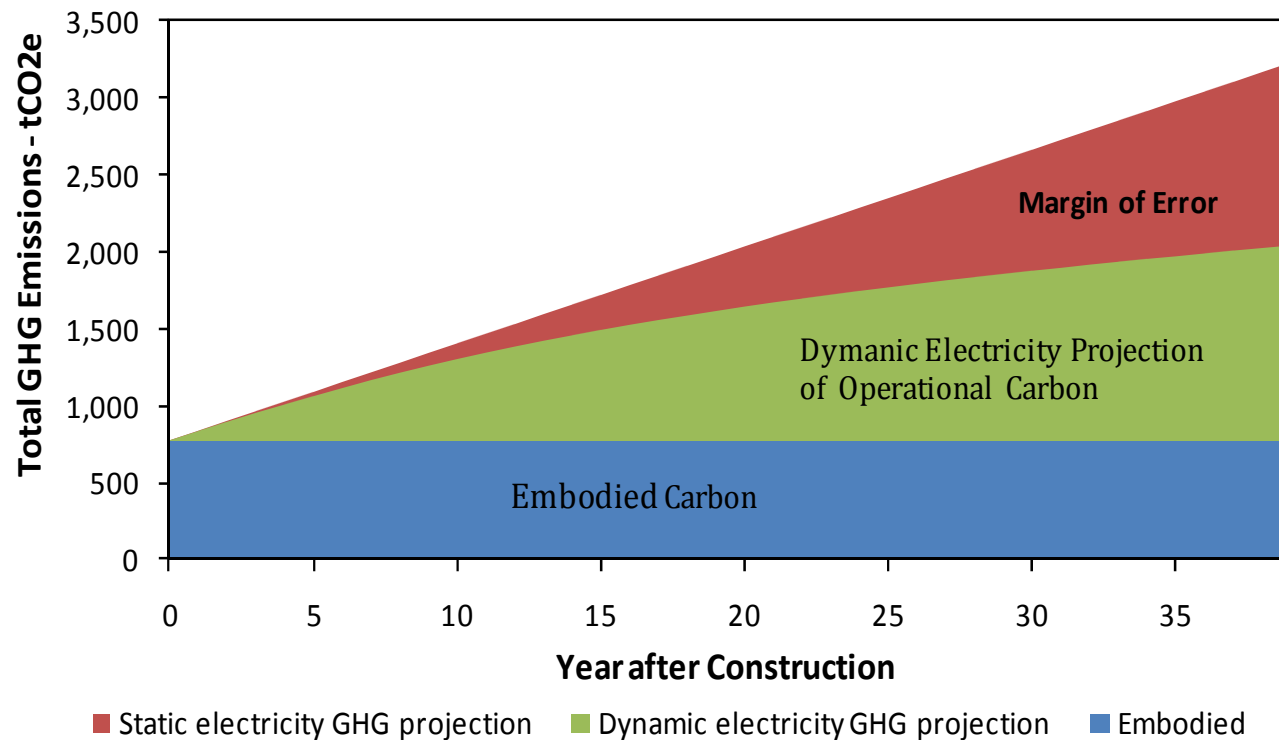
Embodied & Operational GHG emissions for a Domestic Building



Case Study: A Primary School

- A static projection **overestimates** operation emissions by **95%**

Embodied & Operational GHG emissions for a Primary School



Whole Life Carbon: Summary

- Current methods on whole life carbon need to become **more sophisticated**
- A simple and effective improvement is to look at the future of **electricity** GHG emissions
 - This has a **large influence** on the **whole life carbon** results of real buildings
- **Embodied carbon** is more **important** than currently coming out of whole life carbon studies
- As **thermal standards increase** (“zero carbon” homes/buildings) **embodied carbon is becoming an important part of the whole life carbon**

Setting the Landscape

Thank You

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