It’s more than zero carbon: Delivering genuine sustainability in the built environment

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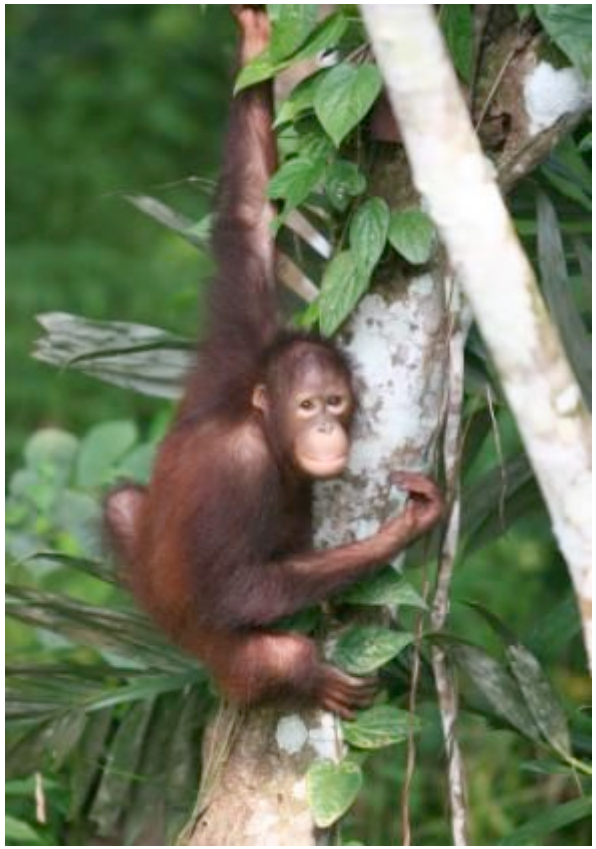
UNITAR / CIFAL Seminar
17th June 2008

Gaia Hypothesis: The earth is a self-regulating environment. All the living organisms and the inorganic material of the planet are part of a dynamic system that regulates the conditions to support life.

If the Gaia Hypothesis tells us anything, it is that we should consider the **whole system,** not just the parts – everything is interconnected, and focusing on one element or issue can have dire and unforeseen consequences…



Whole System Thinking

- Nature is not built-up from isolated blocks, but from a complex web of inter-dependent relationships
    - Human communities are also complex inter-related and inter-dependent living systems

- The danger of the “zero carbon” agenda is that it ignores social and economic sustainability and worse still, it can result in highly perverse outcomes
    - vital that a **whole system** approach is adopted so as to deliver **genuine sustainability**

Are we looking at the problem through the wrong end of a telescope?

Firstly, what do we mean by net-zero Carbon and is it an illusion anyway?

Terminology and definition are currently very confusing. Over the past year, different government departments/agencies have used at least three different definitions:-

Zero Carbon:	no carbon-emitting fuels are burnt on site and no electricity is imported from the grid.
Net Zero Carbon:	carbon emitting fuels are burnt on site, but locally generated renewable energy is exported to the grid to make up for this.
Carbon Neutral:	offsite generated renewable energy is imported from the grid via private wires.

What is a renewable technology or energy source?

- There is no standard definition of what constitutes a “renewable” technology or energy source, different government departments, agencies and programmes recognise various systems, technologies and energy sources as “renewables”.
- “Active” renewable options include:-
  - Biomass/biofuels/biogas
  - Photovoltaics
  - Solar Thermal
  - Heat Pumps
  - Wind Turbine
  - Micro-chp
  - Hydro (including wave/tidal)
  - Energy from waste

Some technologies don’t even feature in any government list of renewable technology but are (arguably) the most effective!

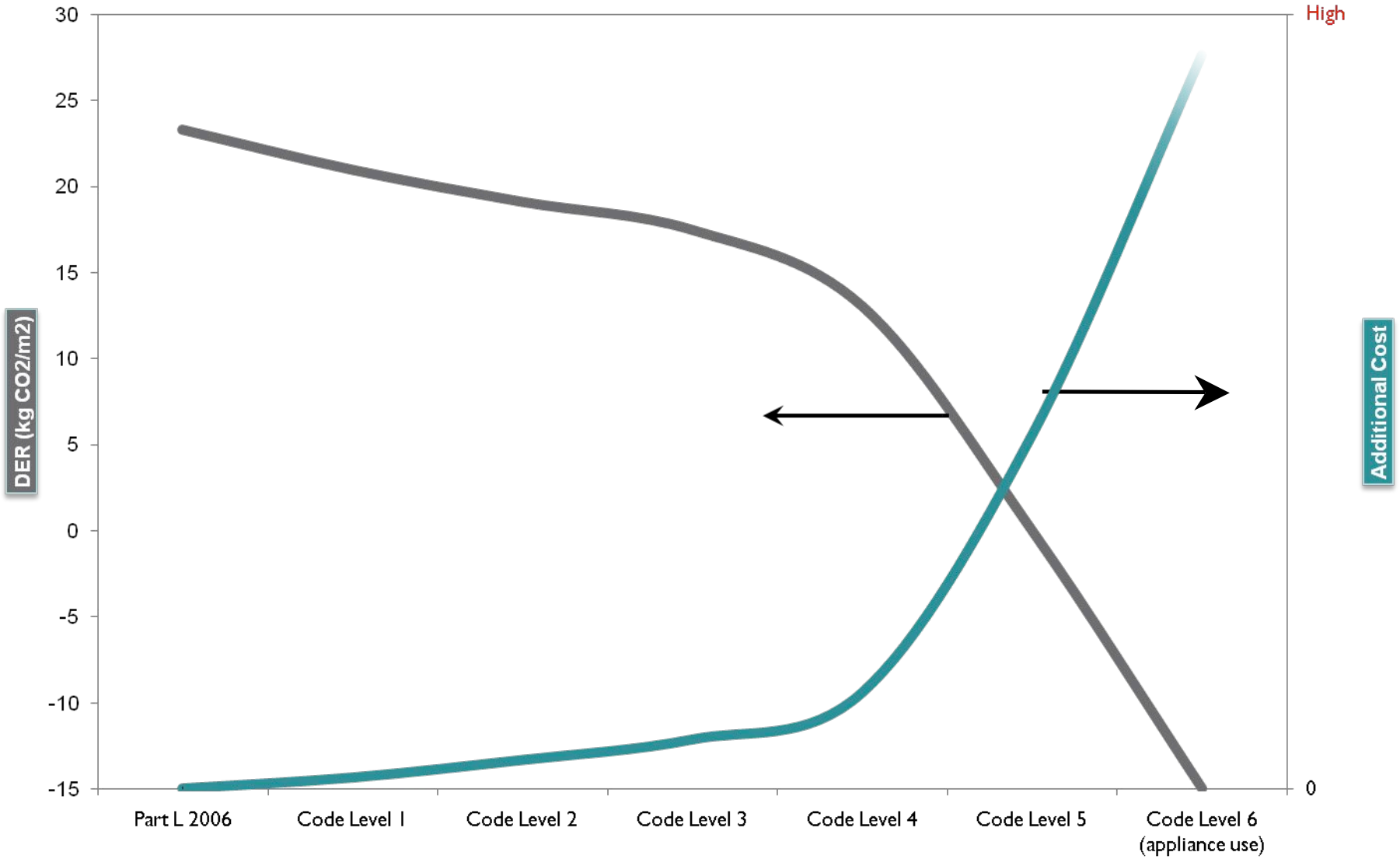
Advanced wind powered solar assisted renewable low carbon drying system

Is zero Carbon offering the consumer a false promise?

The home is only zero-carbon in the sense that it complies with a **theoretical** carbon requirement

- Heating, lighting, hot-water energy requirements are derived from SAP
- Appliance related carbon comes from an HMRC formula which links CO_2 to the m^2 of the house
  - The formula does not have any basis in fact/science!
- The home could only be genuinely zero carbon if lifestyles are prescribed and energy rationed so as to balance onsite generation!
  - Politically unacceptable!

Carbon emissions vs. Code Level –the law of diminishing returns!



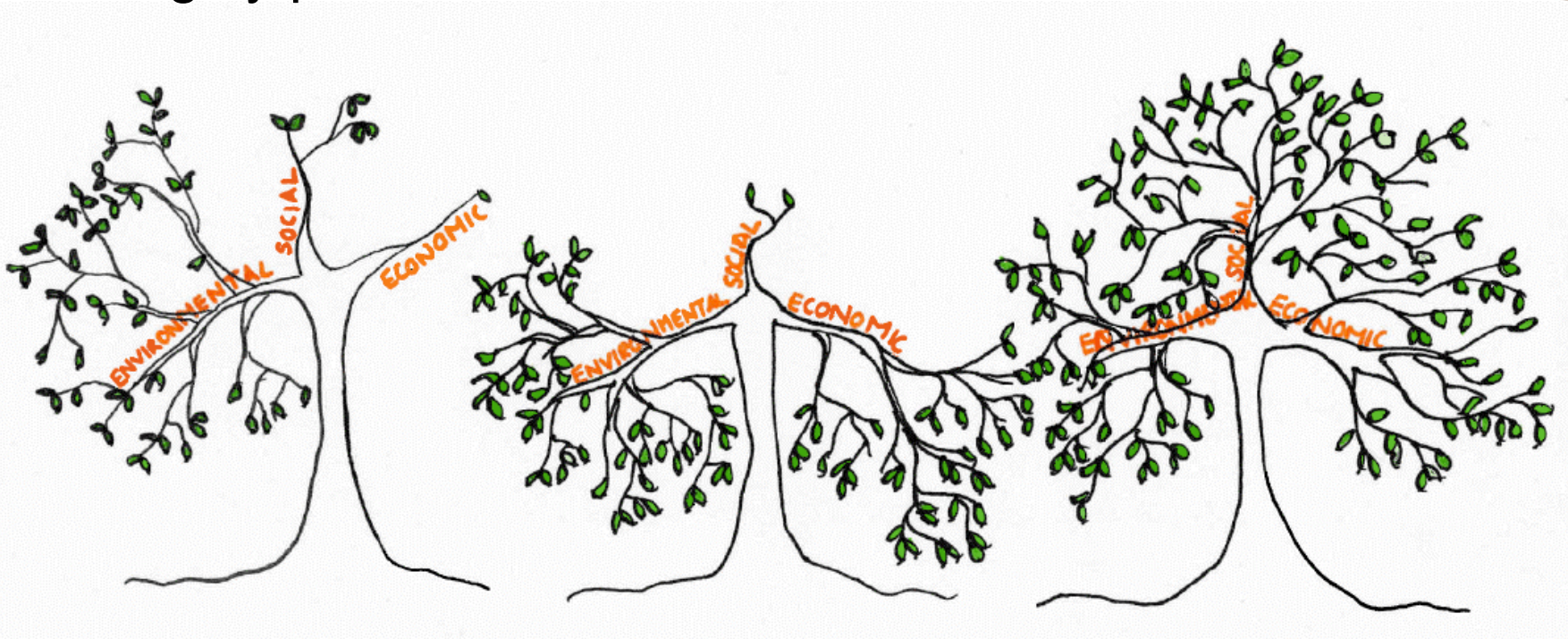
Based on an 80m2 semi-detached house

Stewart Milne –Sigma House, BRE

- "CSH Level 5, near zero carbon"
- Will it deliver in practice?
  - One of the wind turbines has already blown off
  - Given the location and ground turbulence effects, it's very unlikely that the micro-wind turbines will produce anything like the manufacturer's rated output
  - recent research has revealed that many building mounted micro-wind systems in the urban environment are actually **net-consumers** of energy
- A "reality check" is needed urgently
  - Is the **"best"** in danger of becoming the enemy of the good?

Focusing on single issues can lead to:

- Imbalance
- Missed opportunities
- Highly perverse outcomes



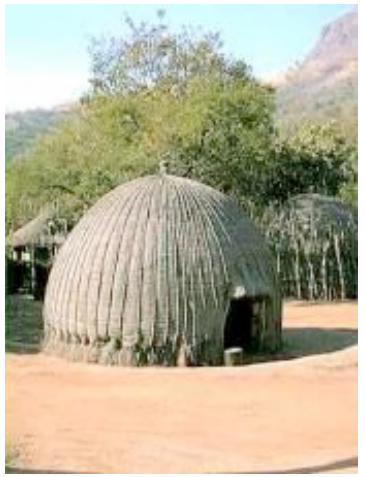
Avoiding perverse outcomes

- **Beware the law of unintended consequences, for example:**
  - Summertime overheating
  - Flood resilience
  - Transport
  - Security
  - Acoustic performance
  - Indoor air quality/Health problems
    - No IAQ regulations
    - c1900 about 50 materials (mostly natural)
    - Now over 50,000 compounds and chemicals

Is the zero-carbon agenda acting as a huge distraction from the vital challenges associated with:

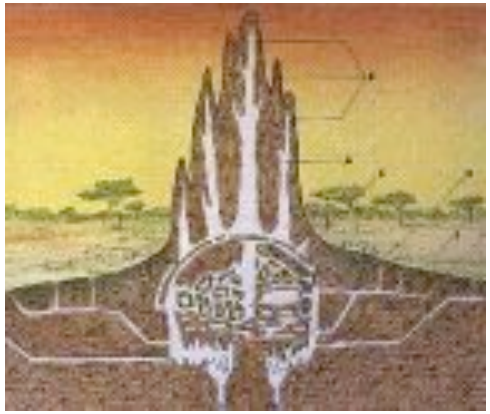
- Reducing carbon emissions from the **existing building stock**
    - An **urgent** inter-departmental government review and strategic plan was promised in November 2003 –it's never materialised!
    - c.f. Germany
- Securing investment/planning for large scale renewables
- In terms of £ invested per Tonne carbon saved, both of these options will provide a much greater/faster return than making new homes "zero" carbon!

Lessons from the past - vernacular architecture



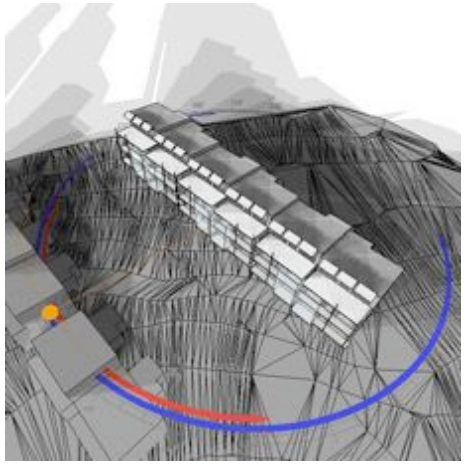
- Vernacular architecture has a form and function which enables
  - comfortable conditions to be achieved (often in very hostile climatic conditions)
  - optimum and sustainable use of indigenous materials
  - low environmental impact

Lessons from nature - biomimicry



- Buildings should fully exploit the natural systems available **for free** to provide :
  - Ventilation
  - Cooling
  - Heating
  - Daylighting
- Climate excluding vs. climate adaptive buildings
  - Bio-climatic design is much more challenging
  - Greater care required in construction, operation and maintenance to achieve optimum performance

Bioclimatic Design

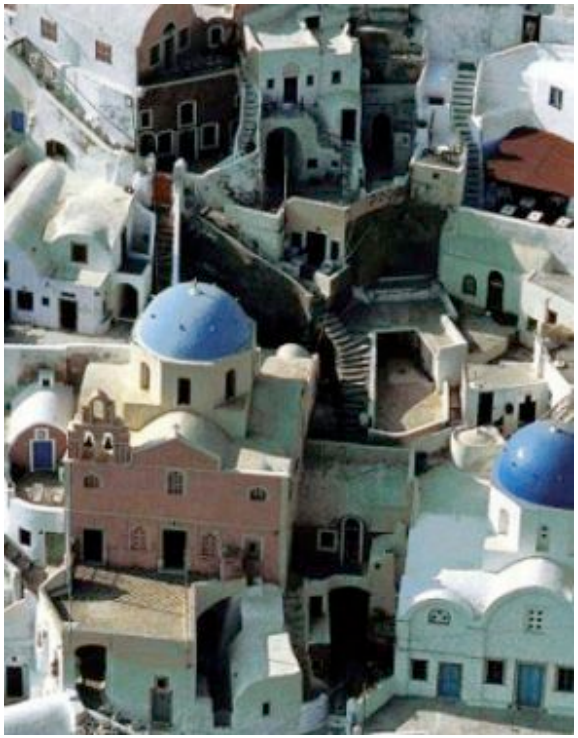


Utilising a site's **free** climatic resource (sun, light, wind, air and water) to maximise comfort and minimise energy use.

A modern term for an ancient approach.

Necessity encouraged early designers to seek optimal comfort from natural resources.

Climate change demands we learn to do the same.



Enhanced wisdom

- Meticulous site analysis
- Advanced modelling

(Computation Fluid Dynamics, thermal modelling, daylight analysis etc.)

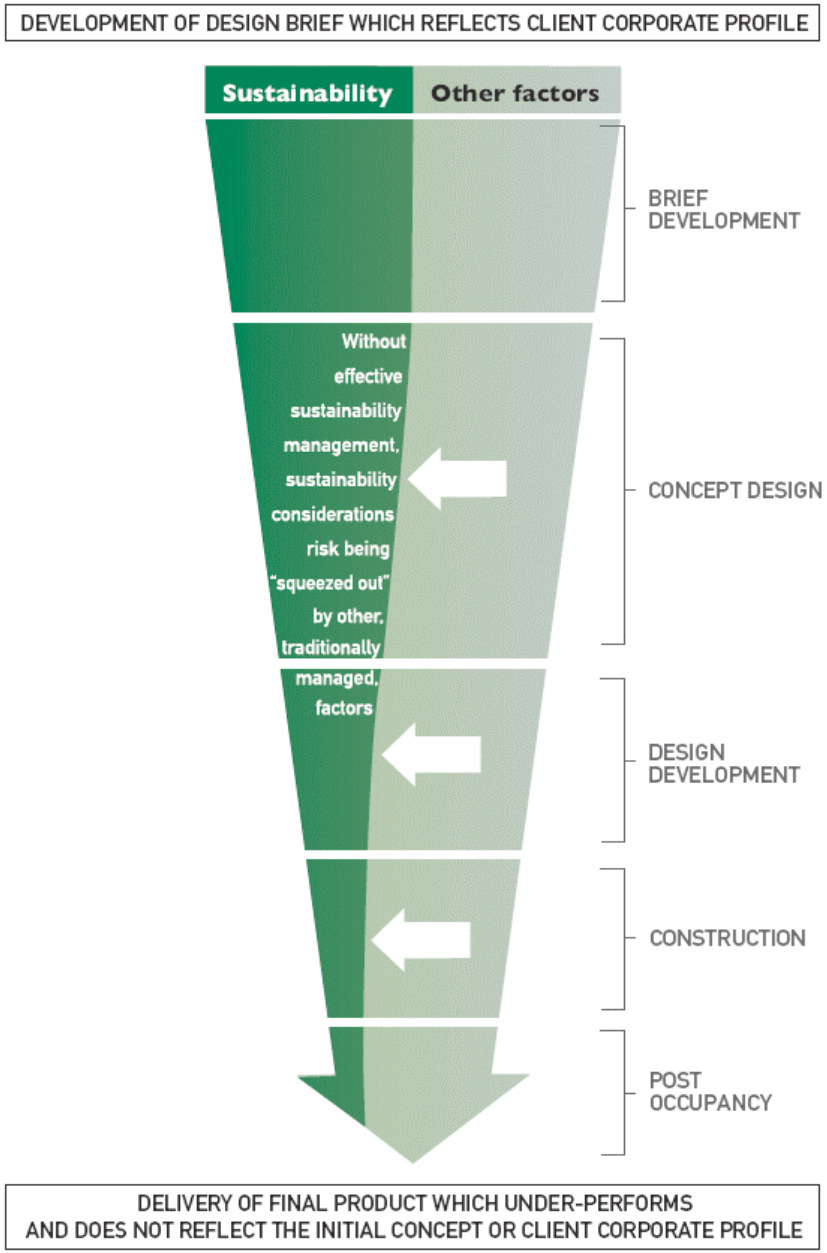
Resulting in **simple** buildings and places which are fundamentally more responsive to location, climate and human needs.

Addressing the challenge of climate change requires a holistic approach to deliver genuine sustainability.

•Whole system thinking is essential:-

- Vital to optimise the entire system, not just parts
- Collaborative, multi-disciplinary, integrated team working
- Working to find natural solutions to reduce our dependence on energy-intensive systems

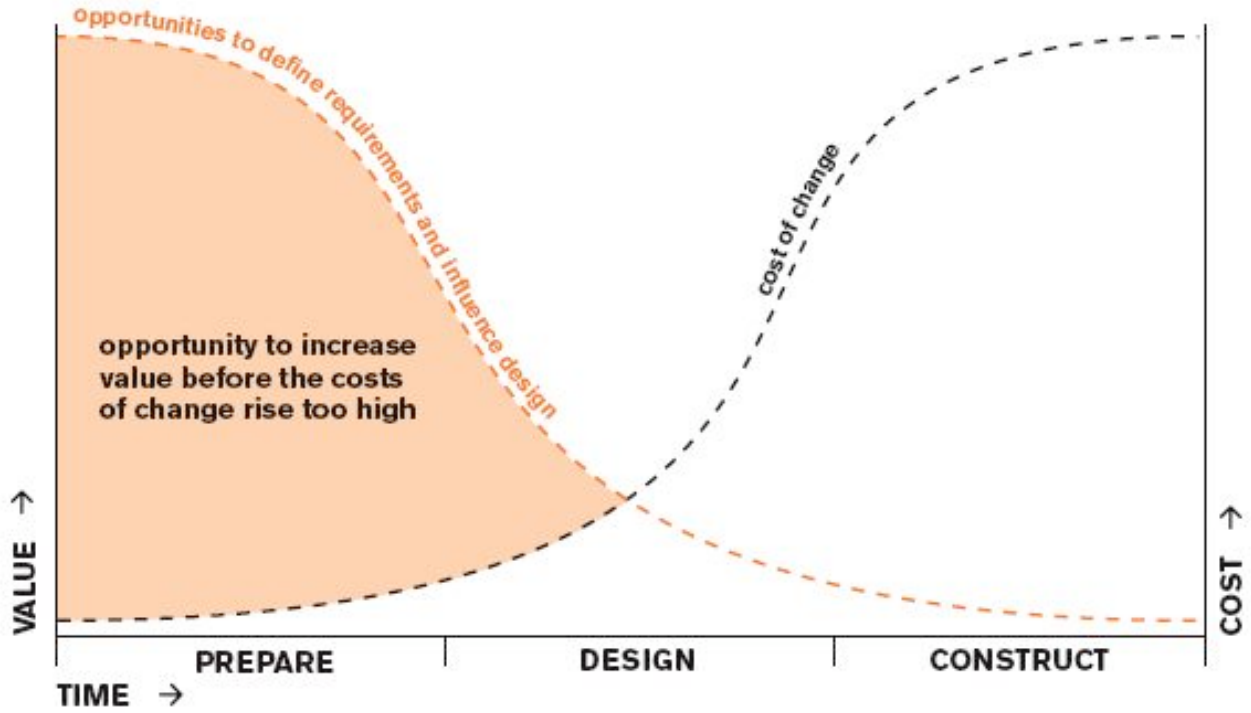
Conventional Design and Construction Process



Sustainability is **challenged** by:

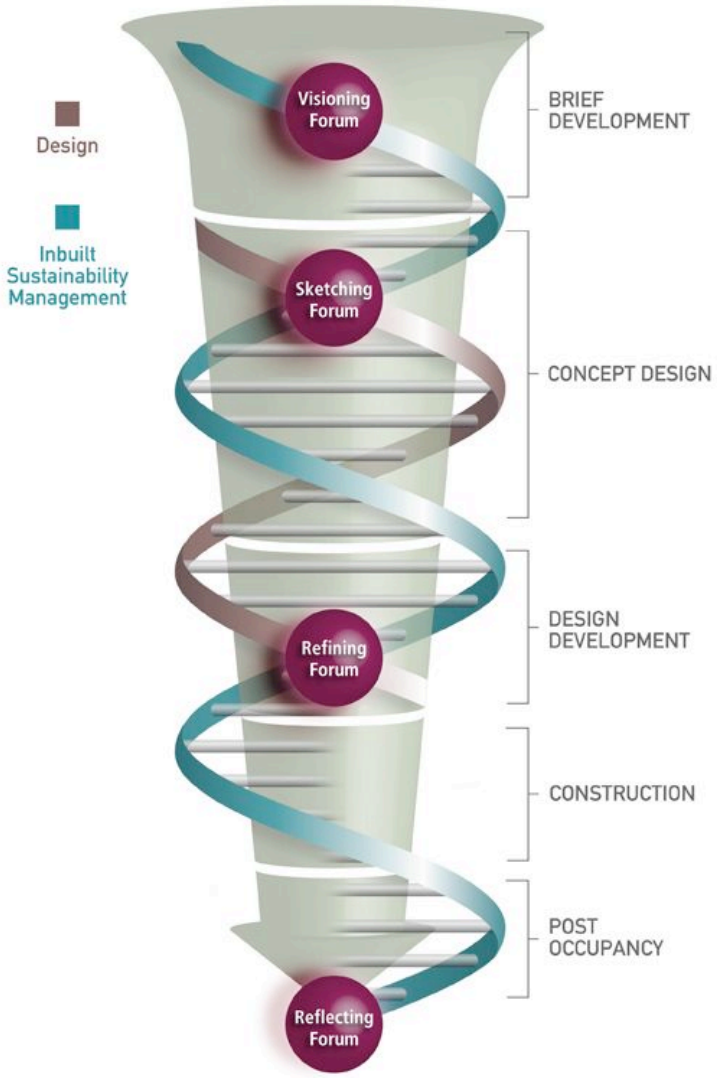
- Insufficient stakeholder engagement
- Lack of clarity in the initial brief
- Value engineering changes with an uncoordinated reappraisal of design
- Lack of monitoring during construction and commissioning
- Incorrect operation and management of the building

Opportunities to exploit whole system thinking



In conventional design 'all the really important mistakes are made on the first day.' Source: Amory Lovins

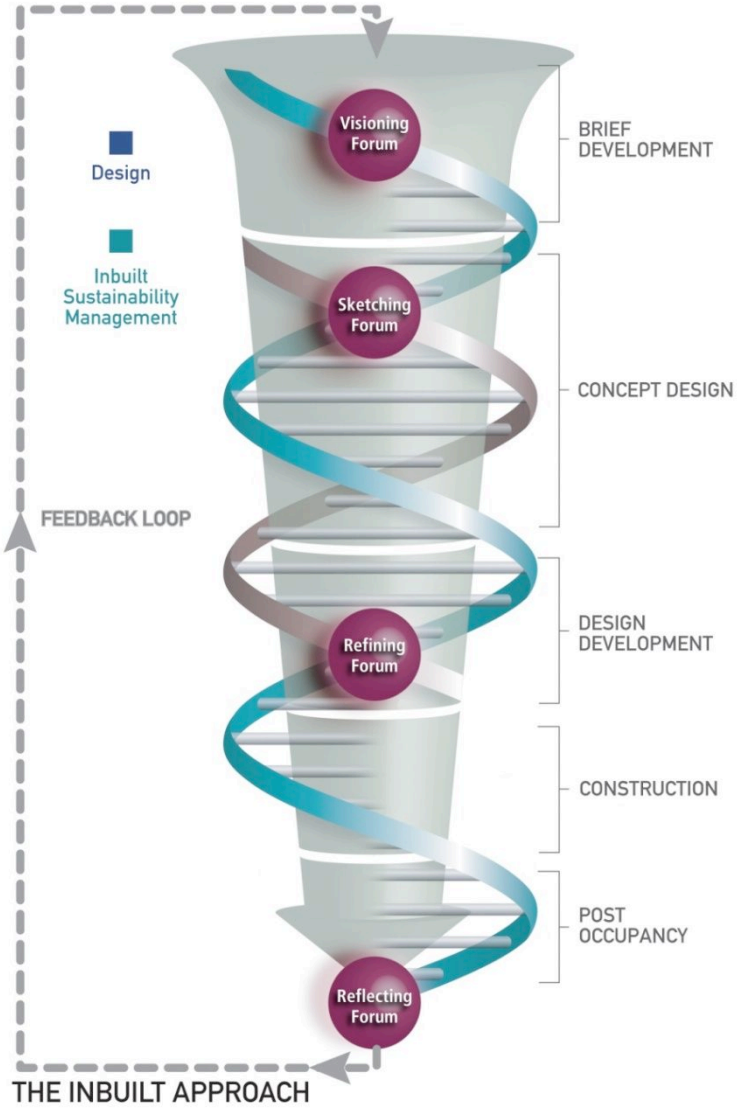
The Inbuilt Approach



Visioning Forums help facilitate collaborative engagement to develop a holistic project vision for sustainability

Sketching and Refining Forums help to maximise the project's sustainability potential and identify unrealised technical and social potential

The Inbuilt Approach



Reflecting Forums help to analyse asset investment / management performance and identify opportunities for improvement

The benefit of our approach

Integrated Design Process		Conventional Design Process
Inclusive from the outset	vs	Involves team members only when essential
Front-loaded — time and energy invested early	vs	Less time, energy, and collaboration exhibited in early stages
Decisions influenced by broad team	vs	More decisions made by fewer people
Iterative process	vs	Linear process
Whole-systems thinking	vs	Systems often considered in isolation
Allows for full optimization	vs	Limited to constrained optimization
Seeks synergies	vs	Diminished opportunity for synergies
Life-cycle costing	vs	Emphasis on up-front costs
Process continues through post-occupancy	vs	Typically finished when construction is complete

Our approach is fully aligned with CABE'S view of sustainability

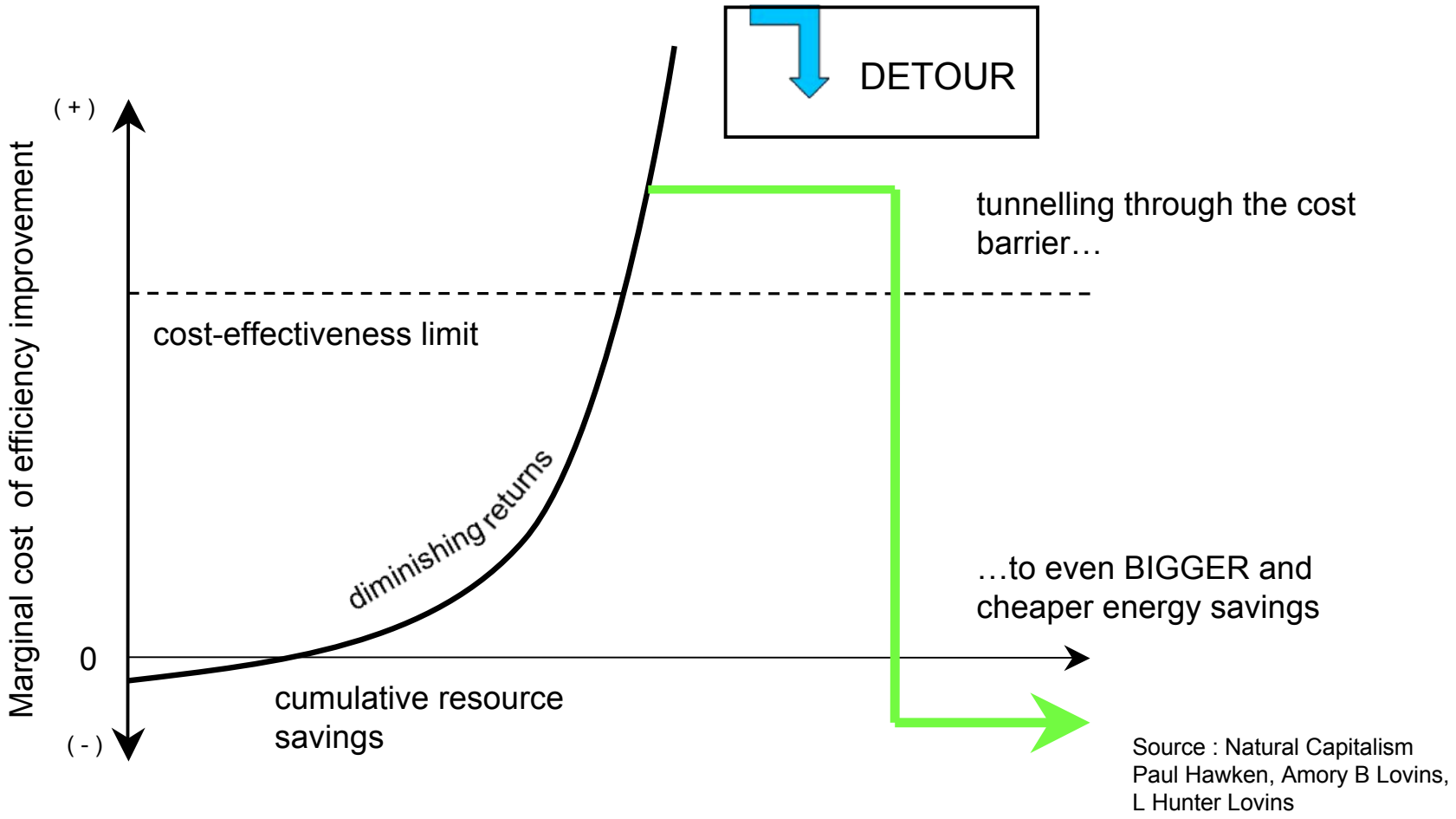
- **Sustainability objectives** should be included in the **outline brief**.
- **Define the parameters** for sustainability and **set firm, auditable targets**.
- **Police these sustainability indicators** with the same rigour as cost issues.
- **Define a process** and specify the advisers you need to make **informed decisions** and **evaluate them**.

Managing Risk and Adding Value

Intelligent Systemic thinking

- Looking for synergistic solutions which address and resolve multiple problems and issues simultaneously
- Working within the constraints of natural systems, whilst fully exploiting the opportunities offered by nature to ventilate, heat, cool and illuminate our buildings.
    - Delivers huge social, human, environmental and economic benefits
    - Optimising the whole system by designing out waste and improving efficiency
    - Doing more with less by tunnelling through cost barriers

Tunnelling through the cost barrier



Source : Natural Capitalism
Paul Hawken, Amory B Lovins, L Hunter Lovins

Example of Whole System Thinking and Tunnelling Through the Cost Barrier

The German PassivHaus approach

The Requirement

- No central heating system
- Not style or construction method prescriptive

The Solution

- Very high standard of insulation
- Ultra-high performance glazing
- Air-tightness of less than $1m^3/hr/m^2$ @50Pa

The achievement

- Over 6000 houses built-to-date
- Healthy, comfortable
- Incredibly low running cost
- No risky/complex technologies
- No conventional central heating system
- Controlled ventilation with heat recovery
    - Substantially reduced incidence of childhood asthma

Designing out the need for technology and unmanageable complexity

What will the future look like?

Hopefully, not like this!

Or like this?

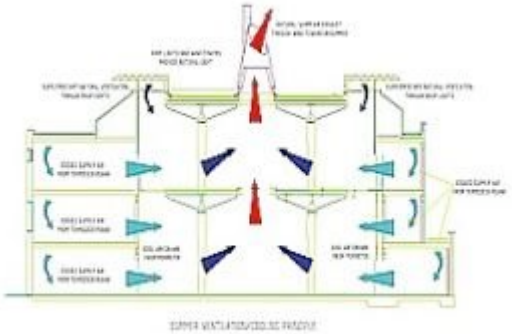
Or this?

Three Exemplars

Housing

greenoak
housing association

Public Building – Brighton and Hove Jubilee Library



Commercial Building
Beaufort Court (RES Group and Inbuilt HQ)
– Zero Carbon Refurbishment of an Egg Farm

Addressing the challenge of delivering a sustainable city

Requires

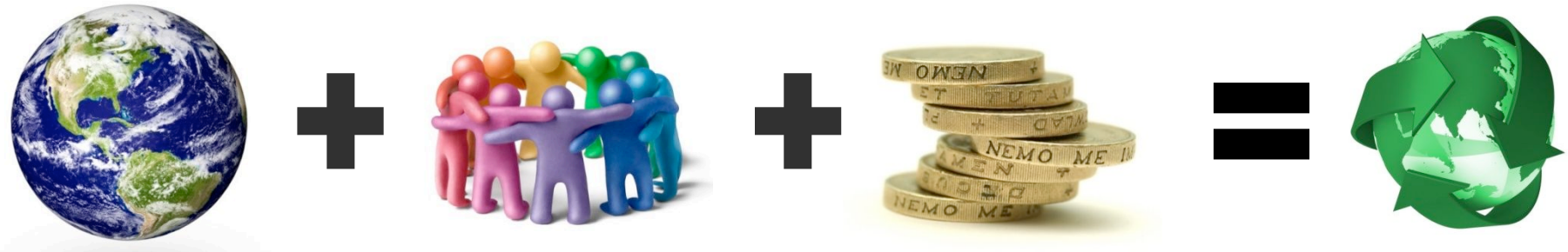
- A willingness (and desire) by a large group of individuals to change their mindsets and behaviours
  - by those in involved in masterplanning, designing and delivery
  - by the future inhabitants
    - e.g. car dependence
- We will not solve the problem by continuing to think and act in ways that created the problem.
- A ‘whole system’ (holistic) approach is essential
  - vital to optimise the entire system, not just parts
  - active (and real) community engagement in the masterplanning process

Smart Growth and New Urbanism

- We advocate the regeneration and growth of our towns and cities, based on :-
  - Creation of walkable communities and public transport infrastructures
  - Land use which enhances the natural environment, ecosystem and biodiversity and provides locally sourced food
  - Mixed use developments with a range of housing types/tenures and a rich mix of architectural styles
    - Vibrant and diverse street culture
    - Child friendly
    - Live/work and homeworking enabled
    - Crime (and fear of crime) designed-out

Delivering Genuine Sustainability

- Sustainability is a complex web of interrelated issues
- **a whole systems approach is essential**
- Collaborative, integrated multi-disciplinary team working
  - “designing-out” technical complexity and cost by rethinking, challenging and improving
  - finding synergistic solutions which address and resolve multiple issues simultaneously



Summary

Let's start looking through the correct end of the telescope and focus on the real imperatives:

- The **existing** building stock
- Installing large-scale renewables where they will be most cost-effective
- Ensuring that the new buildings are ultra-low carbon and incorporate renewable technologies which are correctly sited, cost-effective and reliable (including the optimised use of passive renewables)
- Adopting a "whole system" approach and deliver spaces, places and buildings which are **genuinely sustainable**
- Healthy, safe, productive and inspiring
- Fit for people and the planet
- Sustainability is more than zero carbon and can't be bolted-on:
  - it must be "in-built"

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