



The Road to Zero Carbon
Design and Simulation of Zero Carbon Buildings
CIBSE BSG – 7th November 2013

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Practice Overview

Leading engineering consultancy for the built environment *Multidisciplinary service*

3 UK offices 2 international offices 200 staff *Award Winning* Operations in all sectors

More than 5,000 completed projects Over 33 years of success

Context & Background

Climate Change Act 2008

- UK is committed to reducing CO₂ levels by 80% over 1990 levels by 2050
- Establishes legally binding five-year 'carbon budgets' which cap emissions and set out trajectory to 2050



Climate Change Act 2008

CHAPTER 27

CONTENTS

PART 1

CARBON TARGET AND BUDGETING

The target for 2050

- 1 The target for 2050
- 2 Amendment of 2050 target or baseline year
- 3 Consultation on order amending 2050 target or baseline year

Carbon budgeting

- 4 Carbon budgets
- 5 Level of carbon budgets
- 6 Amendment of target percentages
- 7 Consultation on order setting or amending target percentages
- 8 Setting of carbon budgets for budgetary periods
- 9 Consultation on carbon budgets
- 10 Matters to be taken into account in connection with carbon budgets

Limit on use of carbon units

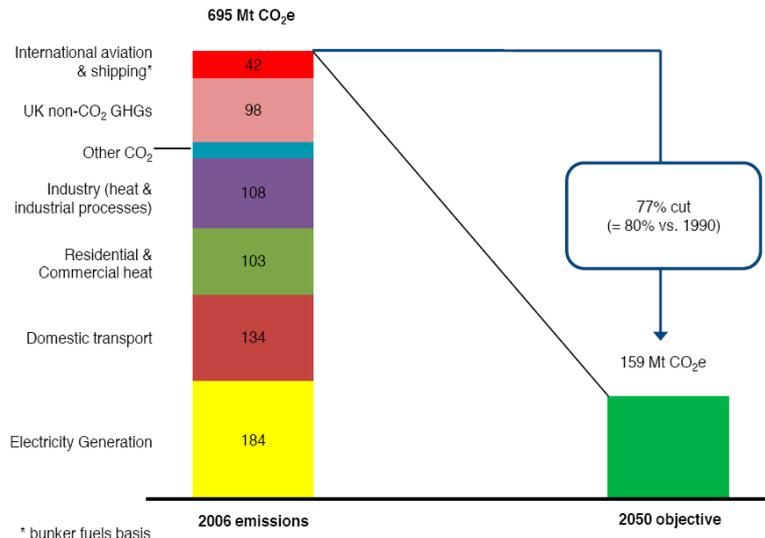
- 11 Limit on use of carbon units

Indicative annual ranges

- 12 Duty to provide indicative annual ranges for net UK carbon account

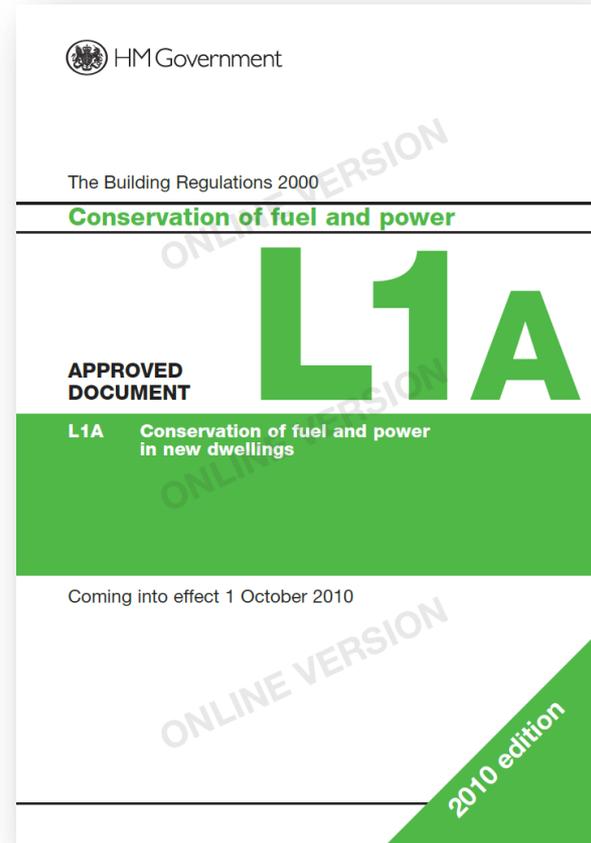
Proposals and policies for meeting carbon budgets

- 13 Duty to prepare proposals and policies for meeting carbon budgets
- 14 Duty to report on proposals and policies for meeting carbon budgets
- 15 Duty to have regard to need for UK domestic action on climate change

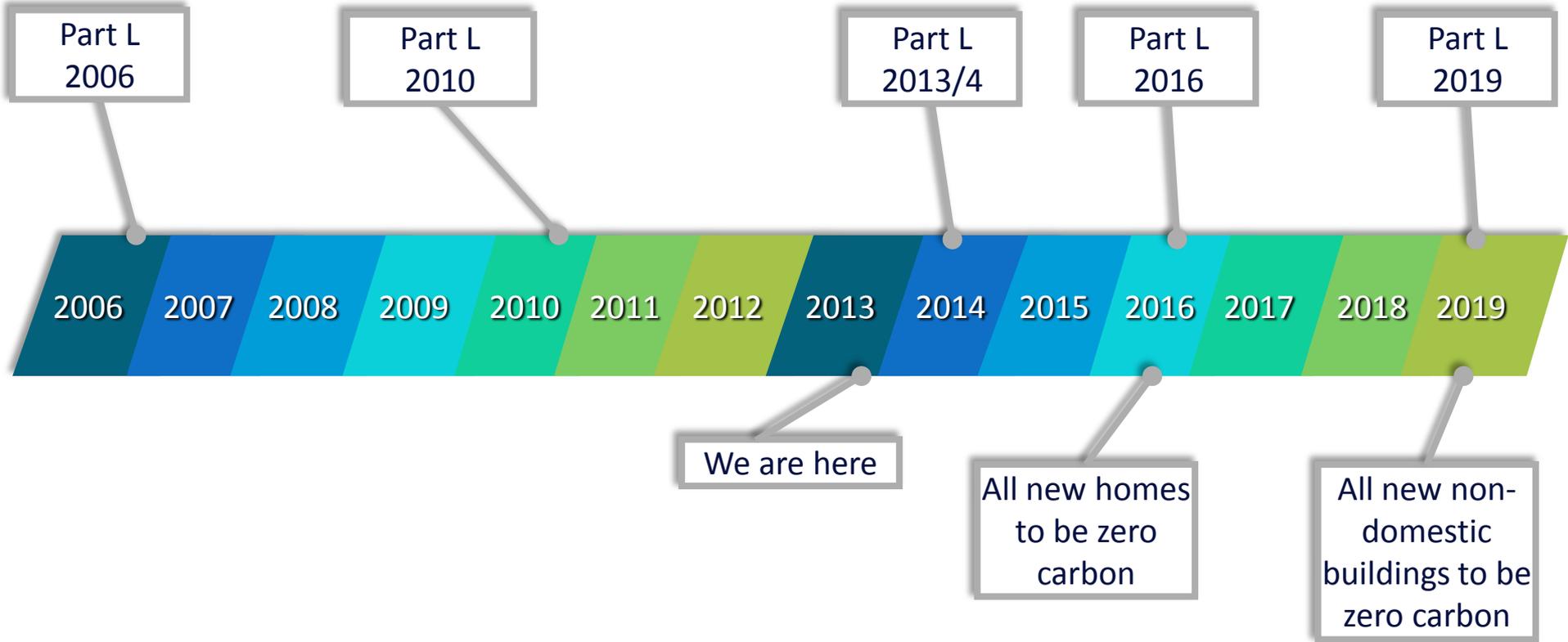


Context & Background

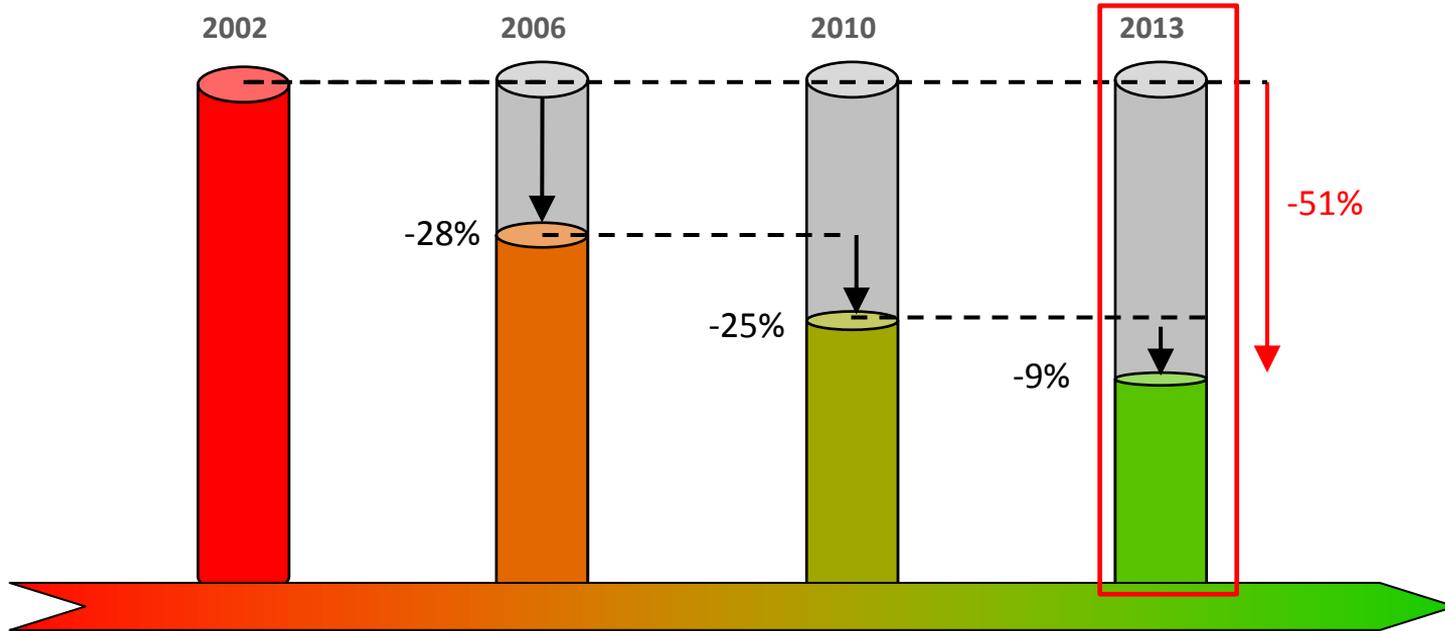
- July 2007 – Building a Greener Future (Policy statement)
 - Zero carbon homes from 2016
- March 2008 – UK Budget
 - Zero carbon non-domestic buildings from 2019
- Energy consumption of buildings legislated for by Part L of the Building Regulations
 - The Approved Documents provide a route to compliance with the regulations



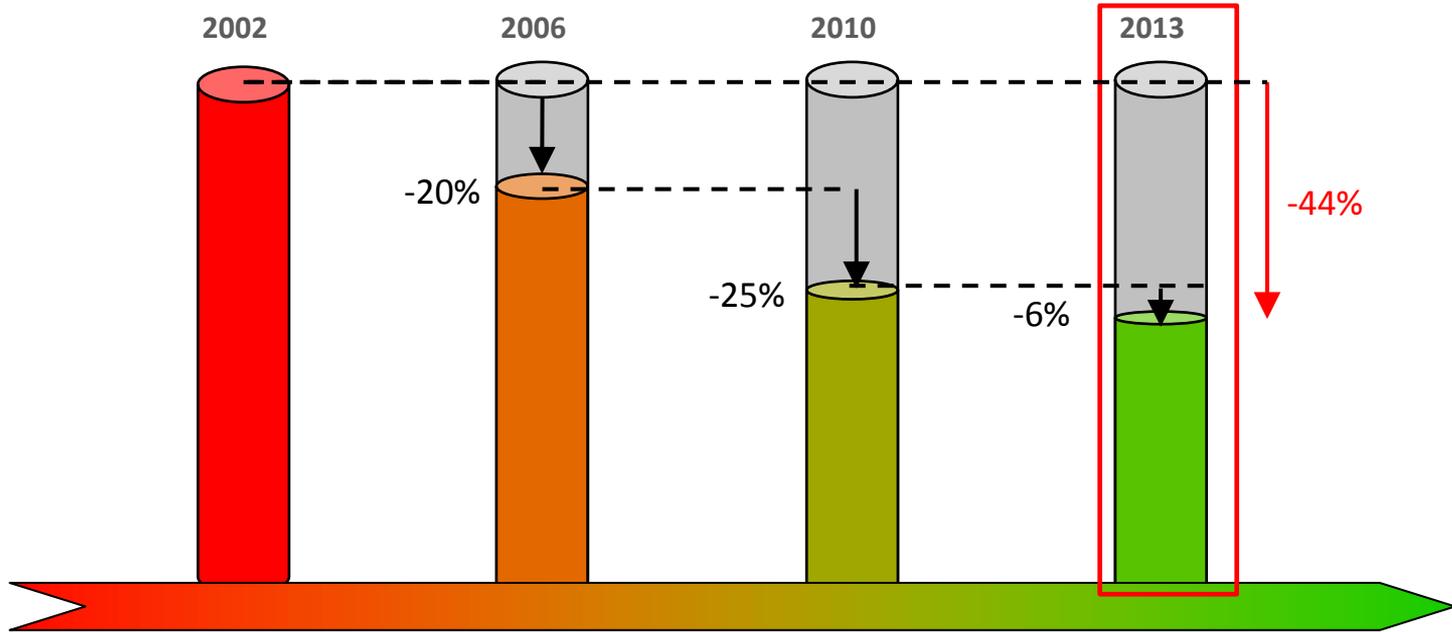
Context & Background



Part L: Non-Domestic Buildings



Part L: Domestic Buildings



Part L: Domestic Buildings

- 2013 also includes adoption of a regulatory fabric standard for new homes
- Fabric Energy Efficiency Standard (FEES) based on Zero Carbon Hub recommendations
- Analysis of building fabric and form only – no systems considered
- Promotes a ‘passive’ approach to design

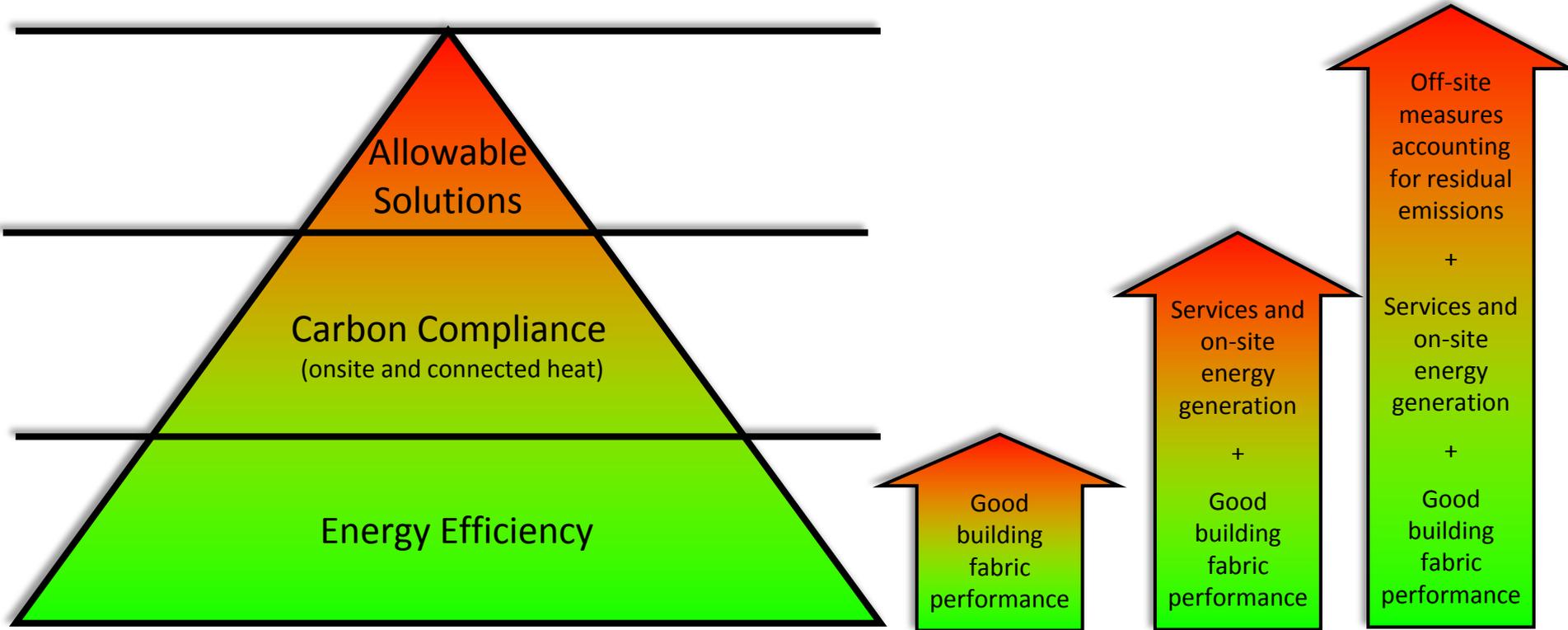


The Zero Carbon Definition

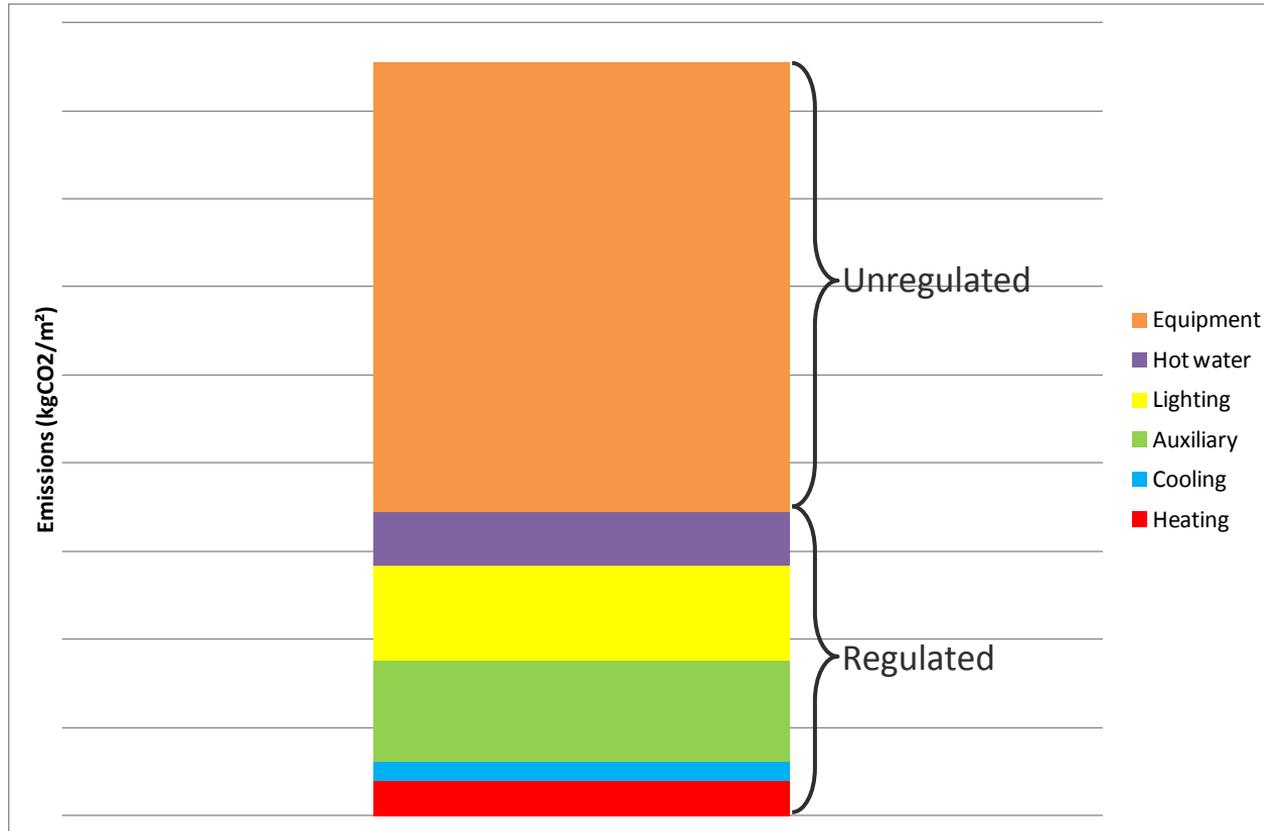
What is a 'zero carbon building'?



The Zero Carbon Definition

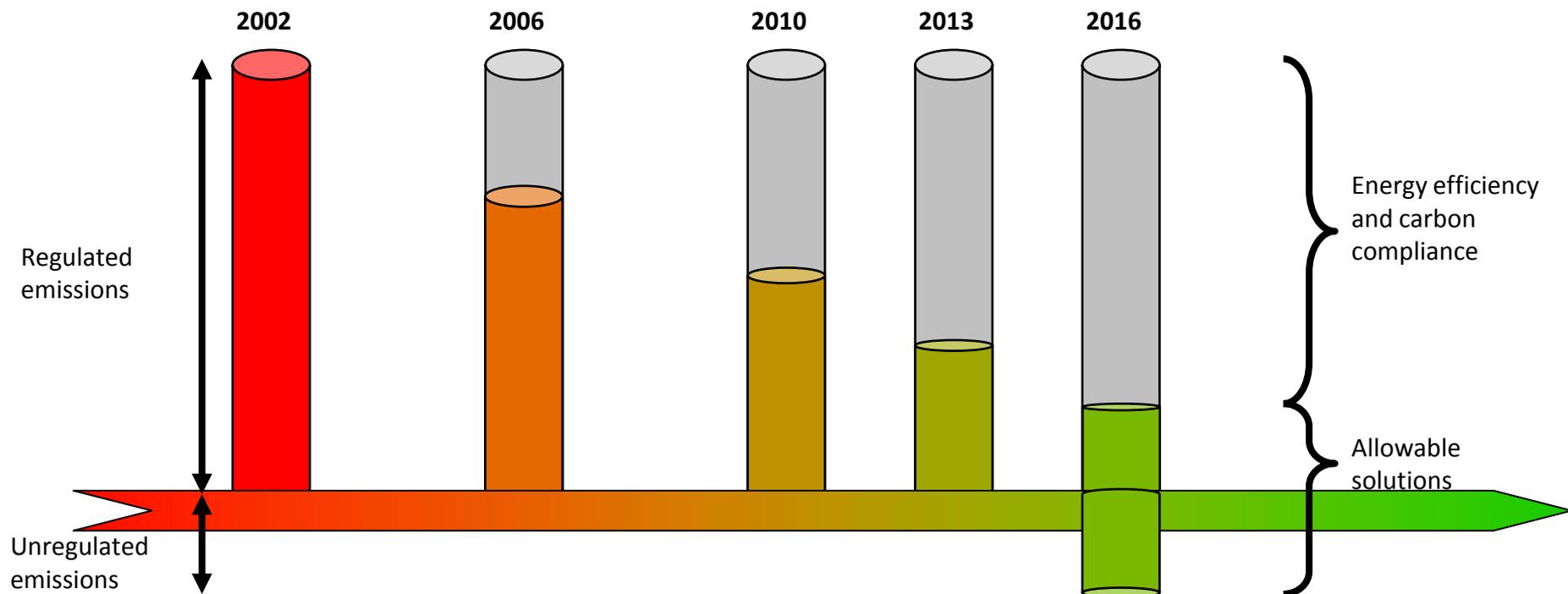


The Zero Carbon Definition



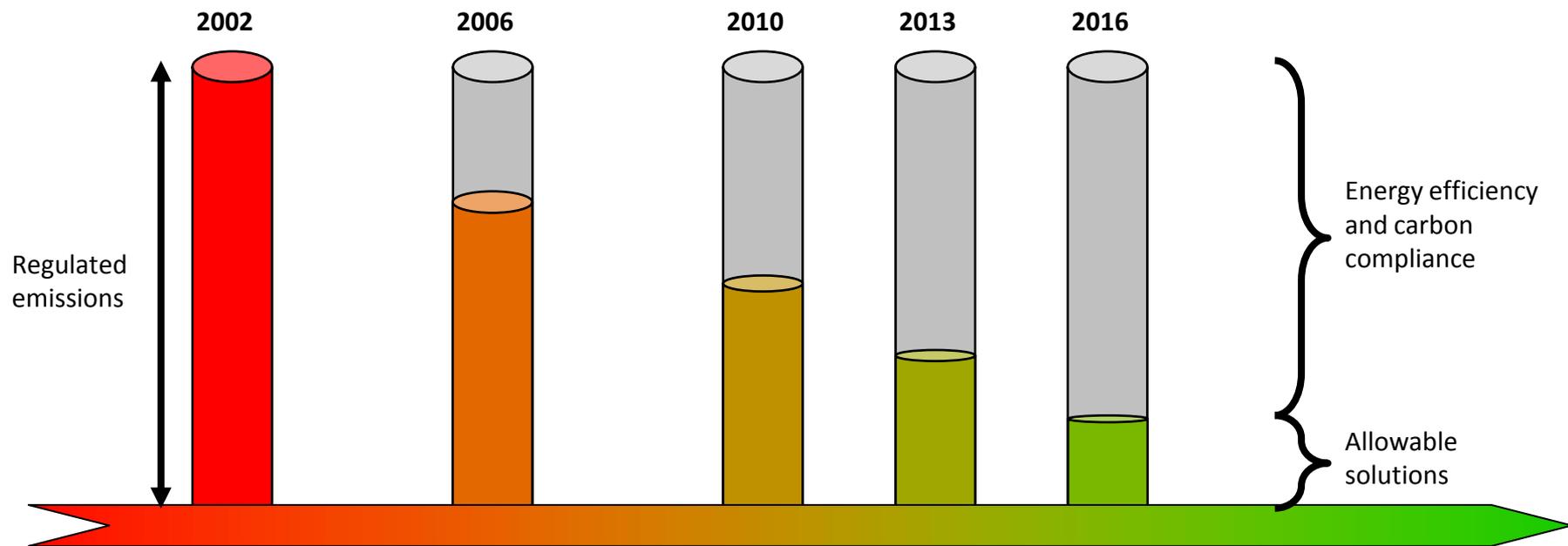
The Zero Carbon Definition

Pre budget 2011...



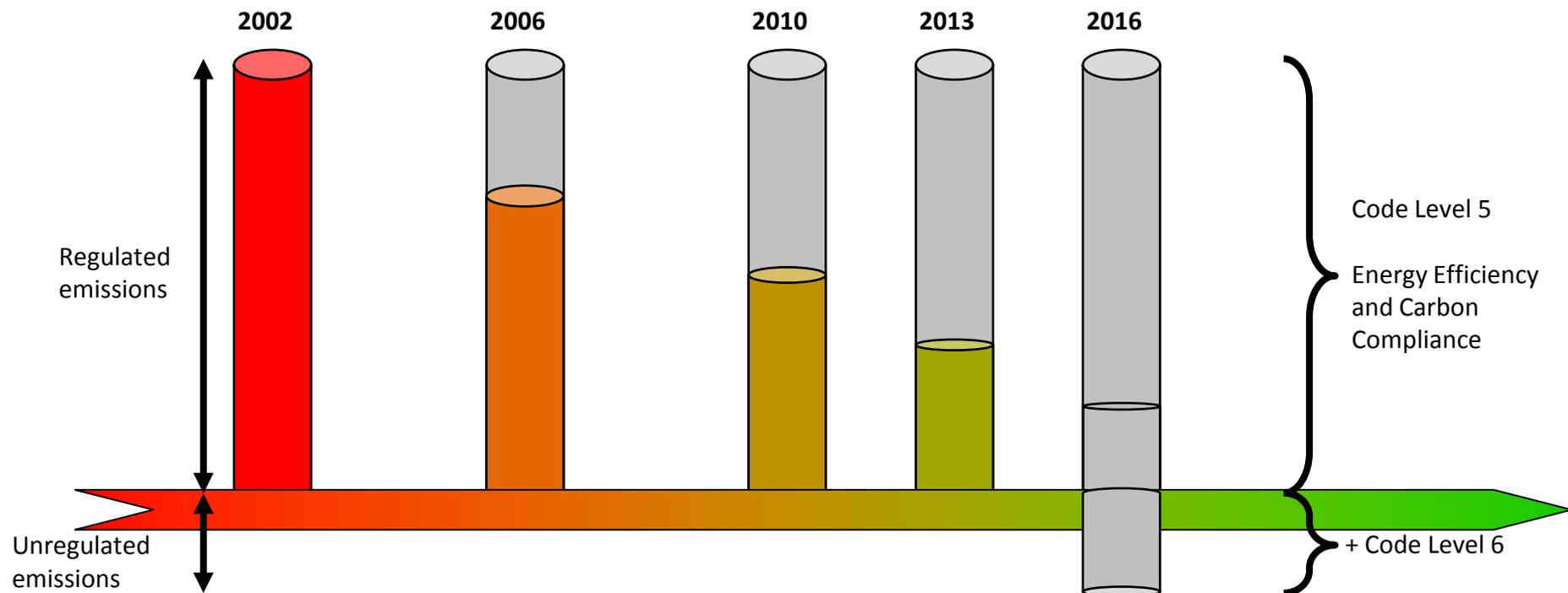
The Zero Carbon Definition

Post budget 2011...



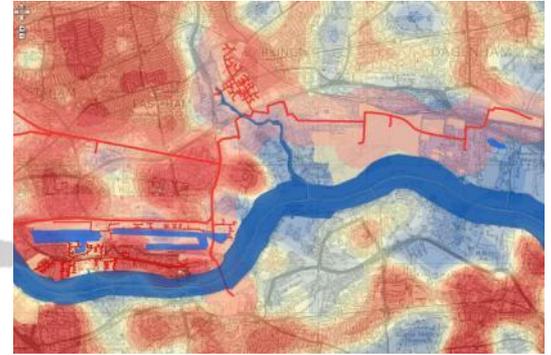
The Zero Carbon Definition

Difference to Code Level 5 & 6



Allowable Solutions

- Allowable Solutions are off site projects that will mop up residual CO₂
 - District energy networks
 - Retrofitting existing buildings
 - LED street lighting
- Up to providers to demonstrate carbon savings
- Projects will need to be independently verified
- Schemes can be provided by:
 - Developer
 - Local authority
 - Third party
- Local projects may take priority
- Not a pre-requisite for planning/construction



How much will Allowable Solutions cost?

- A competitive market but...
- Price no higher than the national CO₂ price ceiling
 - £36 per tonne CO₂/m²?
 - £60 per tonne CO₂/m²?
 - £90 per tonne CO₂/m²?
- Over 30 years...

Case Study Building – £70m construction cost

Building Emission Rate of 19.7 kgCO₂/m² per year

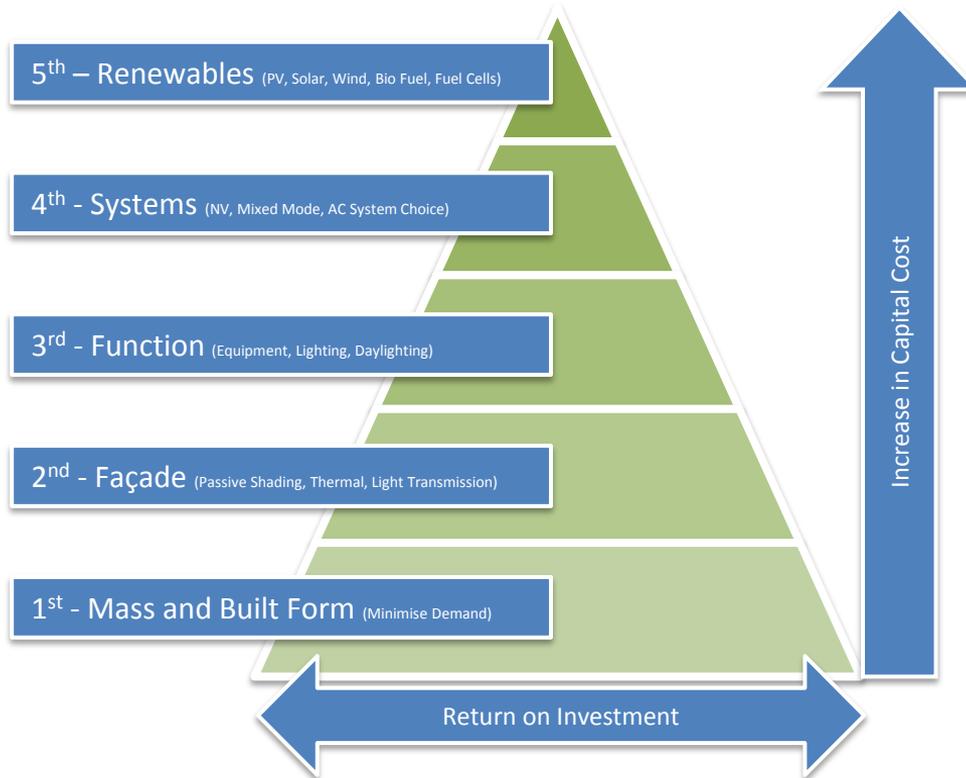
X 25,108m² treated floor area = 495 tonnes CO₂/year

X 30 years = 14,850 tonnes CO₂

X £36 / £60 / £90 per tonne CO₂ = £535k / £891k / £1,334k (Maximum cost)

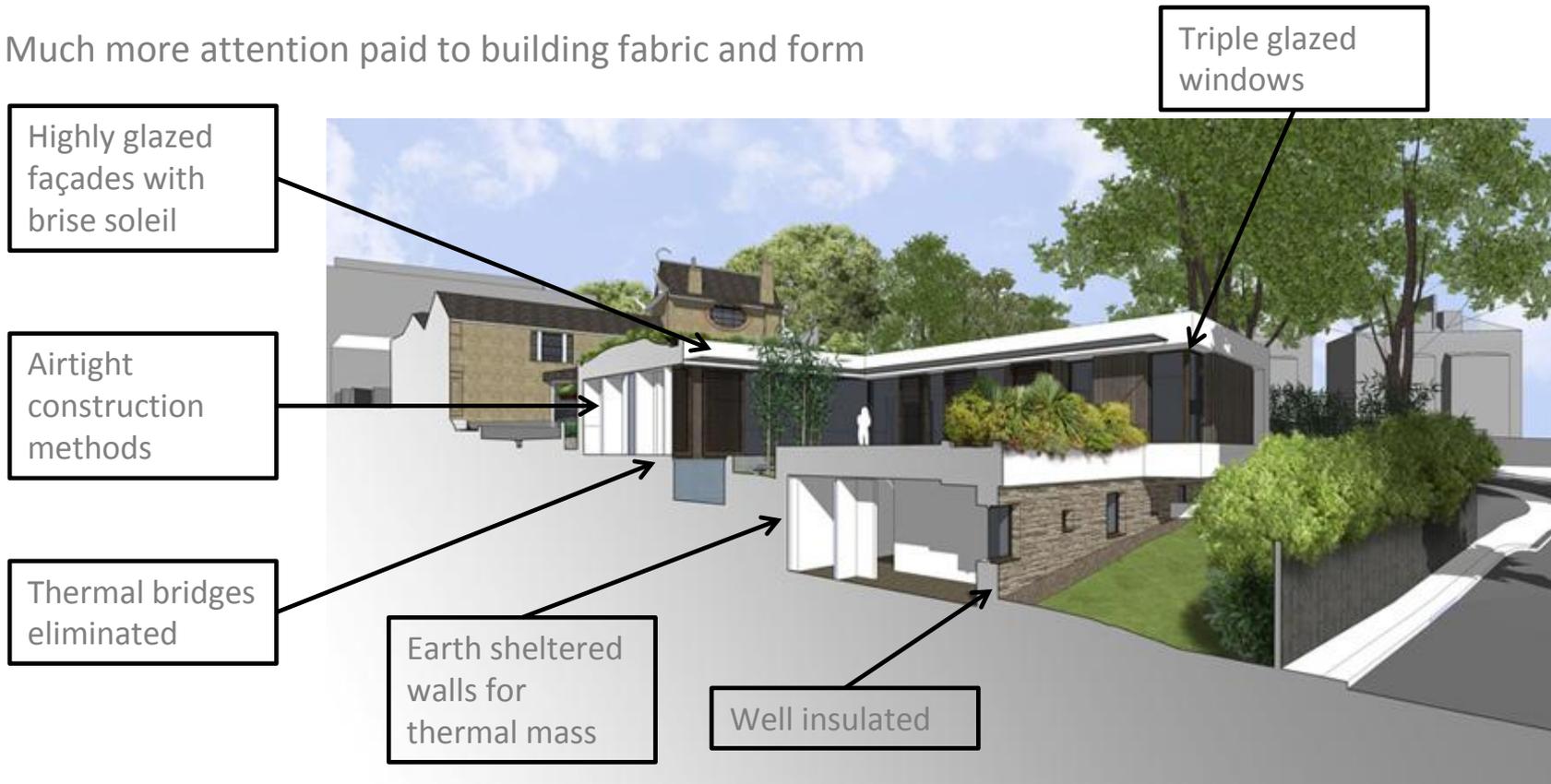
~0.7% / 1.3% / 1.9% construction cost

Effect on Design – Philosophy



Effect on Design – Residential

Much more attention paid to building fabric and form

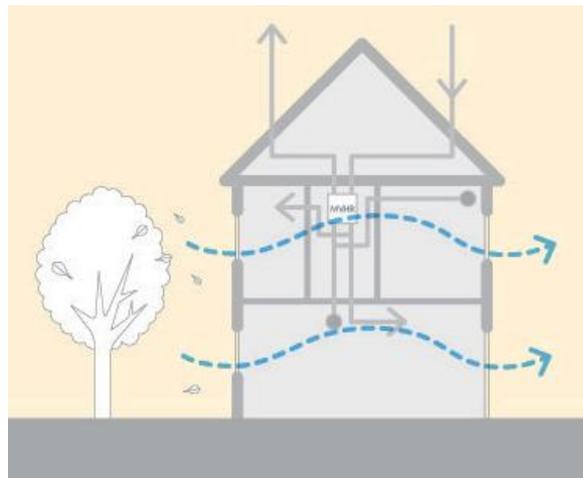


Effect on Design – Residential

- No reliance on any one form of technology
 - Gas boiler
 - Heat pump
 - Solar thermal hot water
 - Photovoltaics
 - Mechanical ventilation with heat recovery
- Mitigating overheating risk will be a significant consideration
- Residential glazed facades will have to work harder

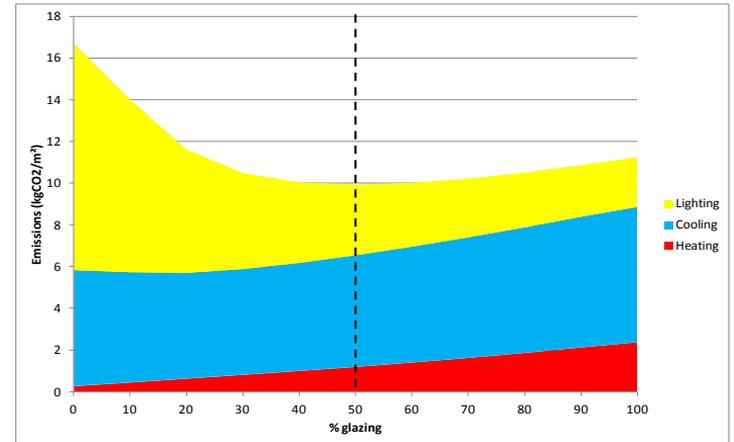


25°C 40°C 60°C



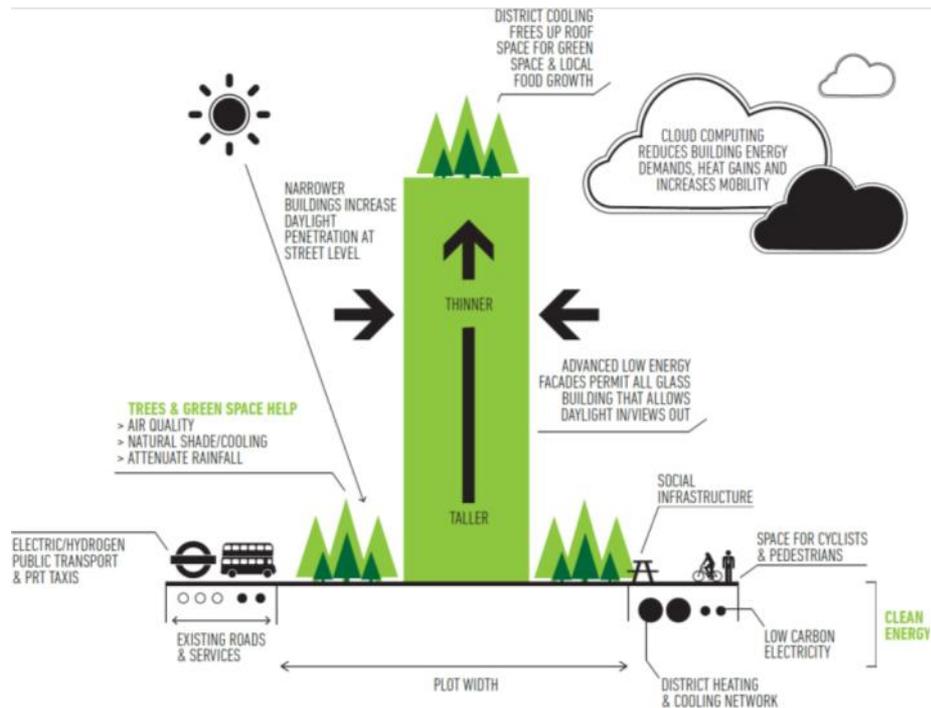
Effect on Design – Non Domestic

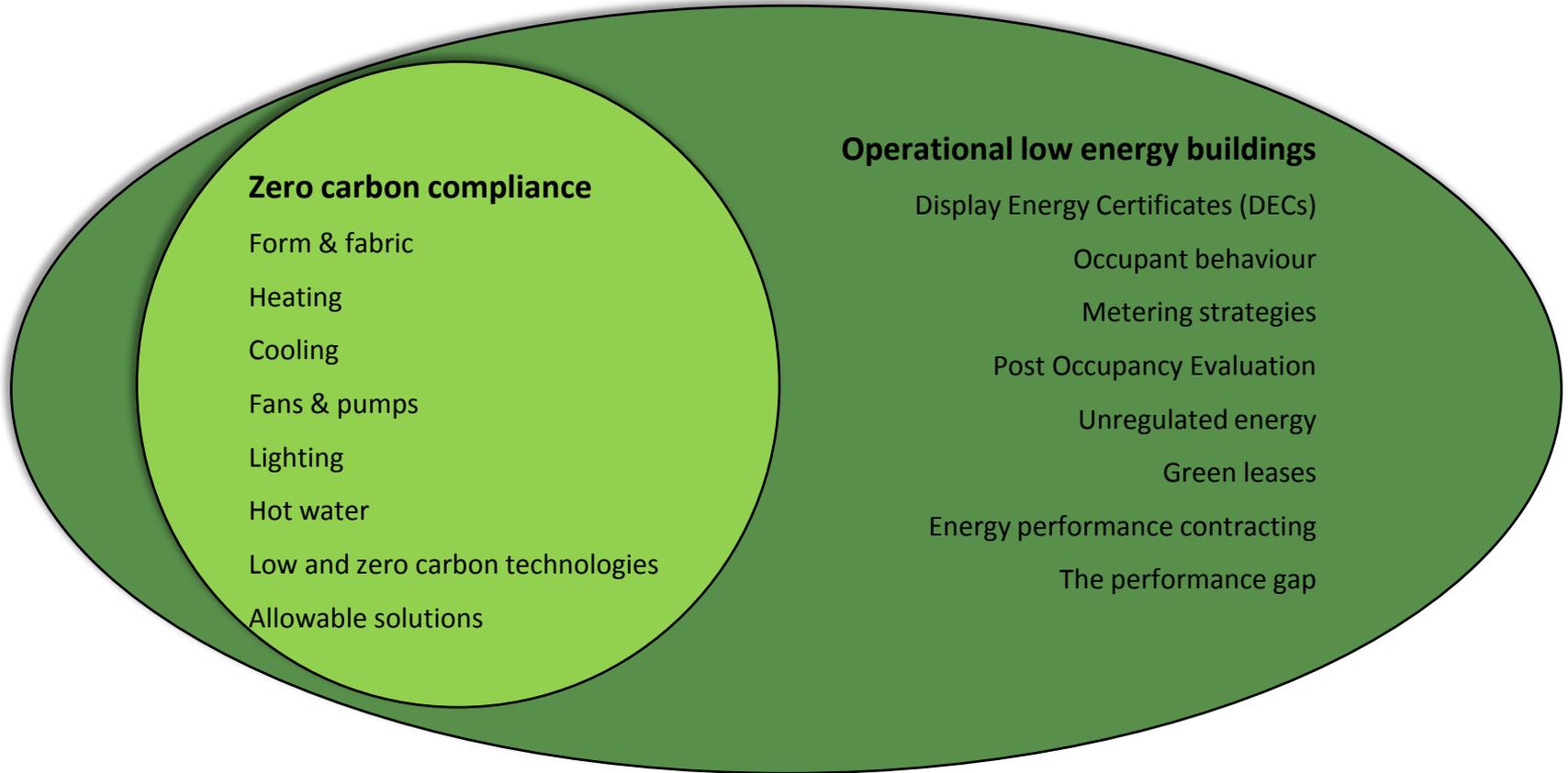
- Greater range of end uses – no ‘one size fits all approach’
- Built form has less impact for buildings dominated by internal heat gains
- Commercial buildings can only push facades so far
 - Deeper floorplates
 - Balance between heating, cooling and lighting
 - Thermal comfort
- Passive design still plays a major part in mitigating operational emissions



Effect on Design – Non Domestic

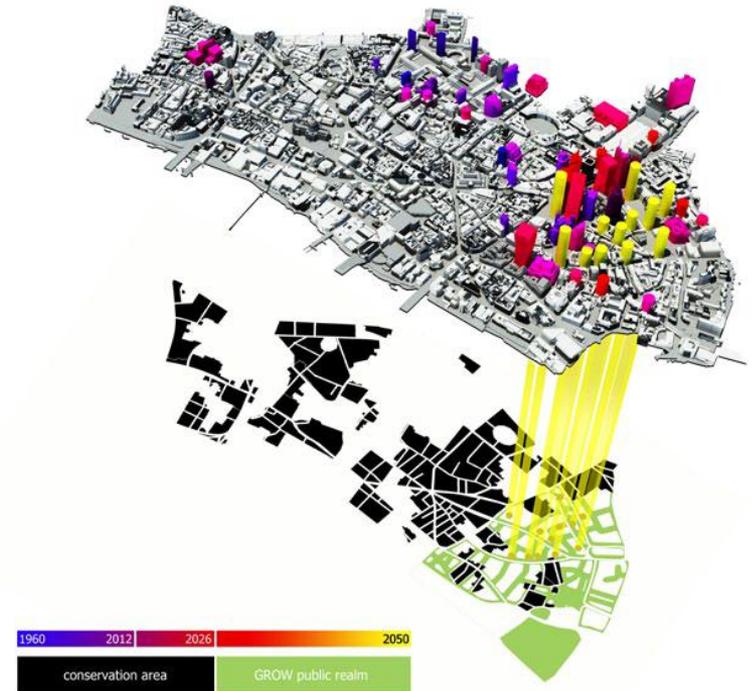
- Mixed mode ventilation
 - Cleaner, quieter electric vehicles
- ‘Innovative’ technology becomes the norm:
 - LED lighting?
 - Displacement ventilation?
 - Turbocor chillers?
 - Thermal storage and phase change materials?
- Renewables contributions from planning policy?





Summary

- Continuing reductions in new build CO₂ emissions as we move towards **zero carbon**
- Introduction of **fabric standard** for new dwellings
- **Allowable Solutions** the final part in the zero carbon jigsaw
- **Pragmatic** and **flexible** design approaches possible
- **Fabric first** approach recommended for all buildings
- Zero carbon in **operation** will go beyond designing for compliance





Many thanks!