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community, opportunity, prosperity

EFFICIENCY OF ENERGY USE
The Role of Materials

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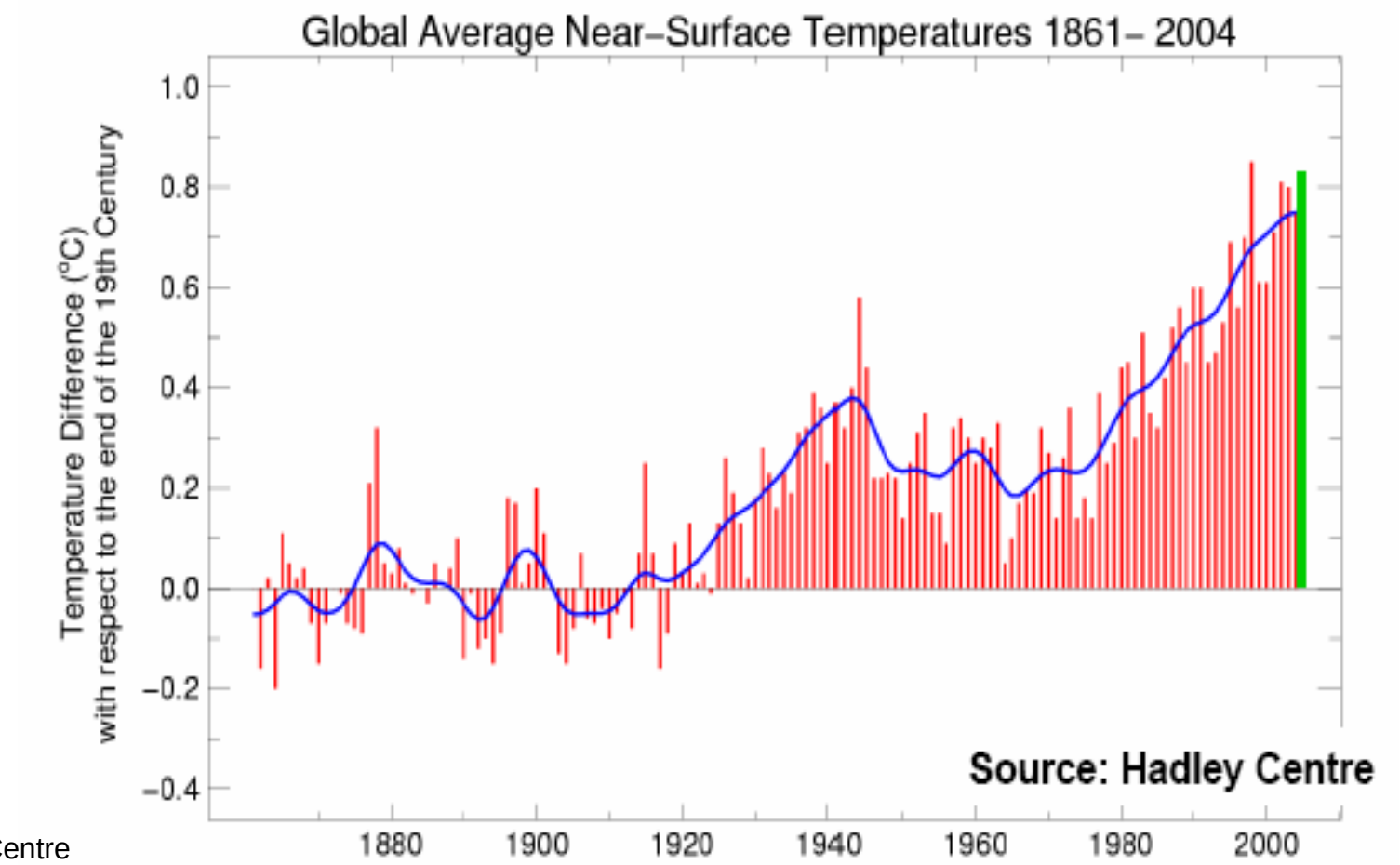
Setting the Scene

1 Mitigating Climate Change

2 Reducing the Urban Heat Island

The scientific evidence is undeniable

Climate change is already happening….
...the Earth has warmed by 0.7°C since 1900



Hadley Centre

We are already observing changes

- Six out of last eight years have been the warmest on record
- Ecosystem changes
  - Species have been moving poleward by 6km on average each decade
  - Seasonal biological events (e.g. flowering and egg-laying) have been occurring 2 - 3 days earlier each decade
  - The warming of the oceans is bleaching coral reefs, in 1998 almost 90% of the Great Barrier Reef experienced bleaching
- Ice sheets are melting and contribution to sea level rise. Arctic sea ice has declined by 20% since 1979
- Average sea levels are rising at 1-2mm a year, increasing flood risk around world's coast

This is already affecting the UK and scientists are predicting further changes

Annual / seasonal averages

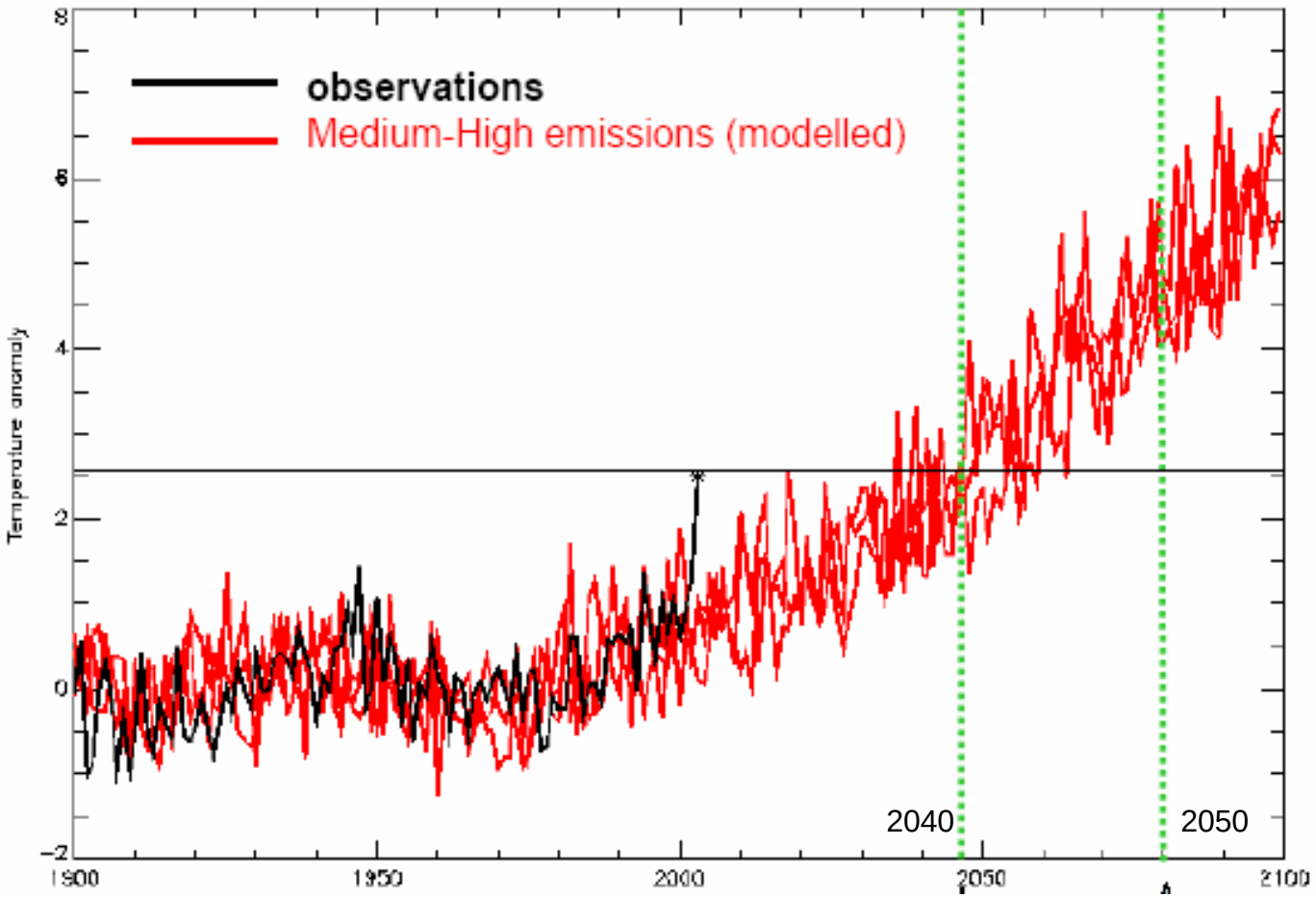
- Warmer/drier summers (spring and autumn too)
- Milder, wetter winters
- Rising sea levels

Extremes

- More very hot days
- More intense downpours of rain
- Possible increase in storms in winter

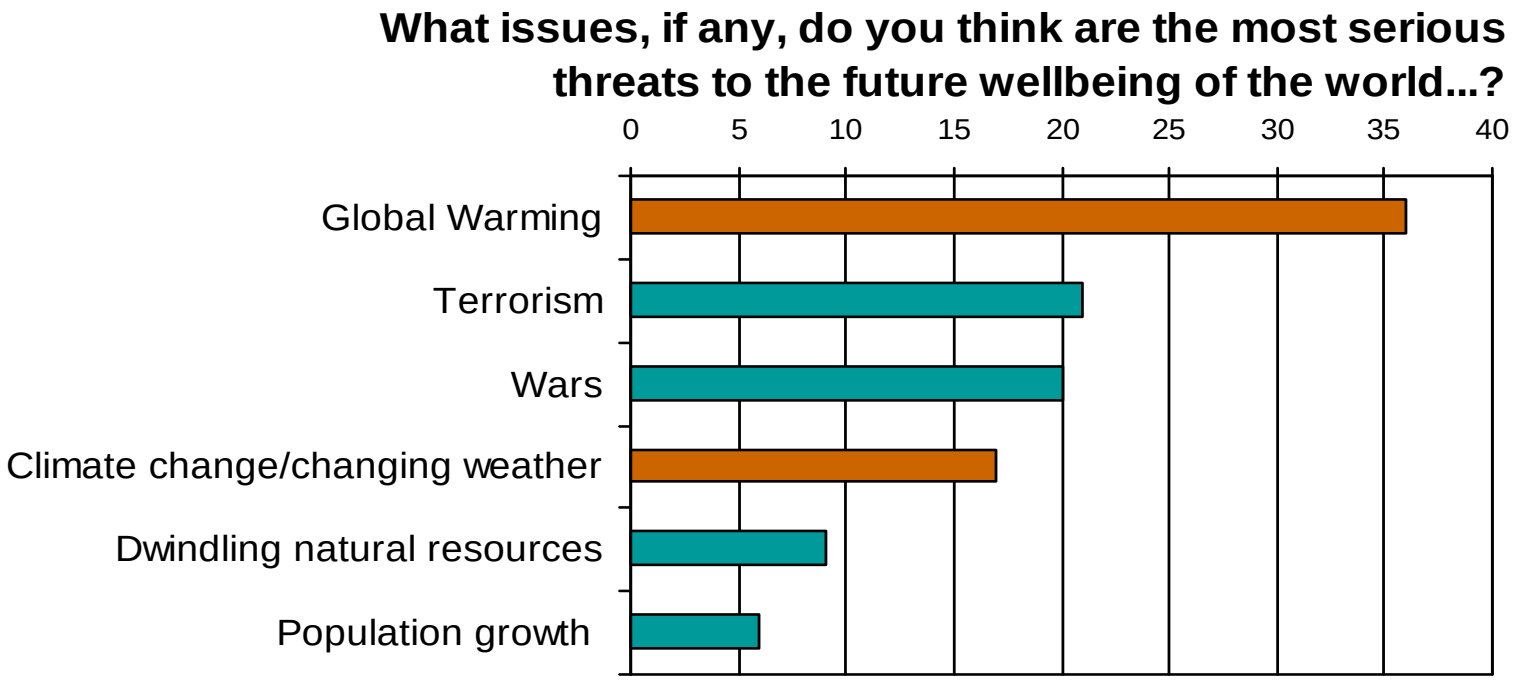
Summer 2003 heat wave could be normal by 2040 …
…..and cool by 2080s

European summer temperatures



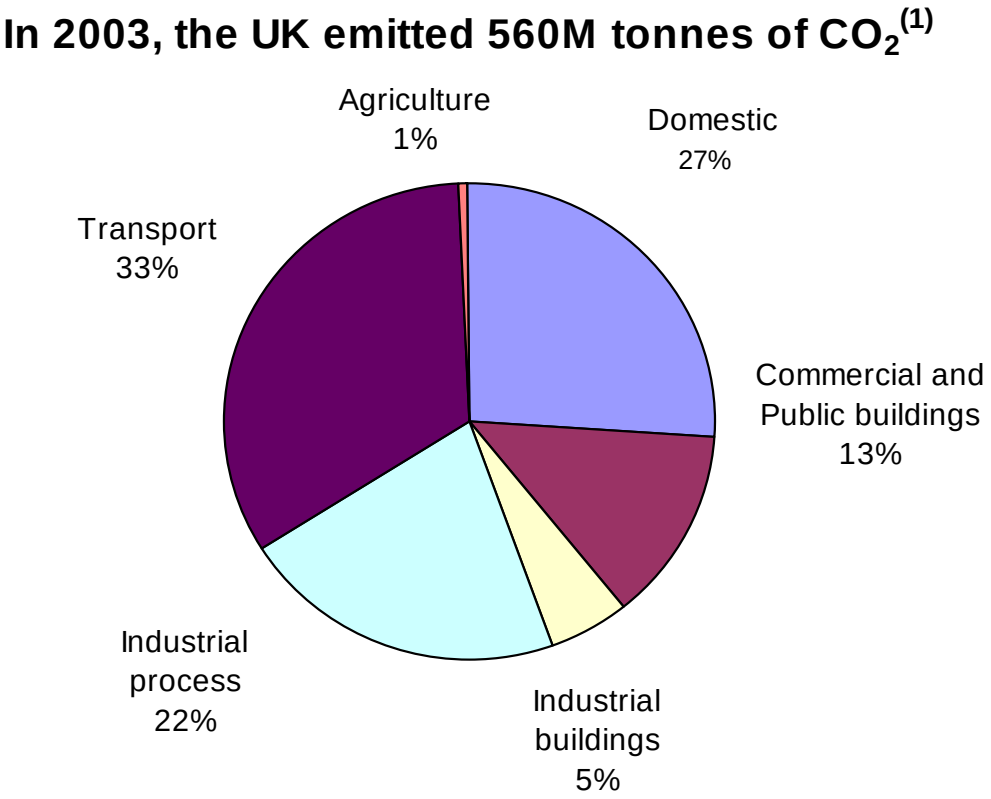
The climate change message is getting through to the public

Recent (September 2006) IPSOS MORI poll showing global warming and climate change are top of the public's agenda



The built environment can have a large impact on climate change

Carbon emissions from energy use in buildings account for nearly half of UK emissions; our homes 27%



(1) Source: Dukes 2003 and B

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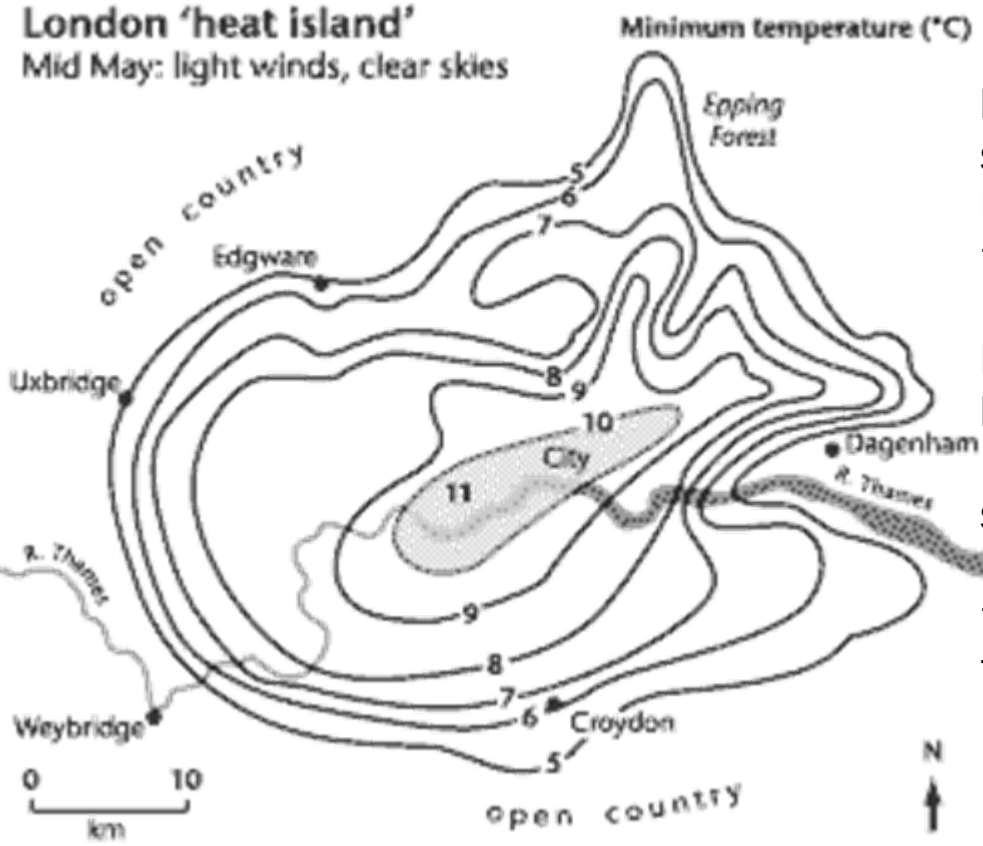
Urban Heat Island

Is not the same as climate change but brings similar issues

The table below summarises some of the differences in various weather elements in urban areas compared with rural locations.

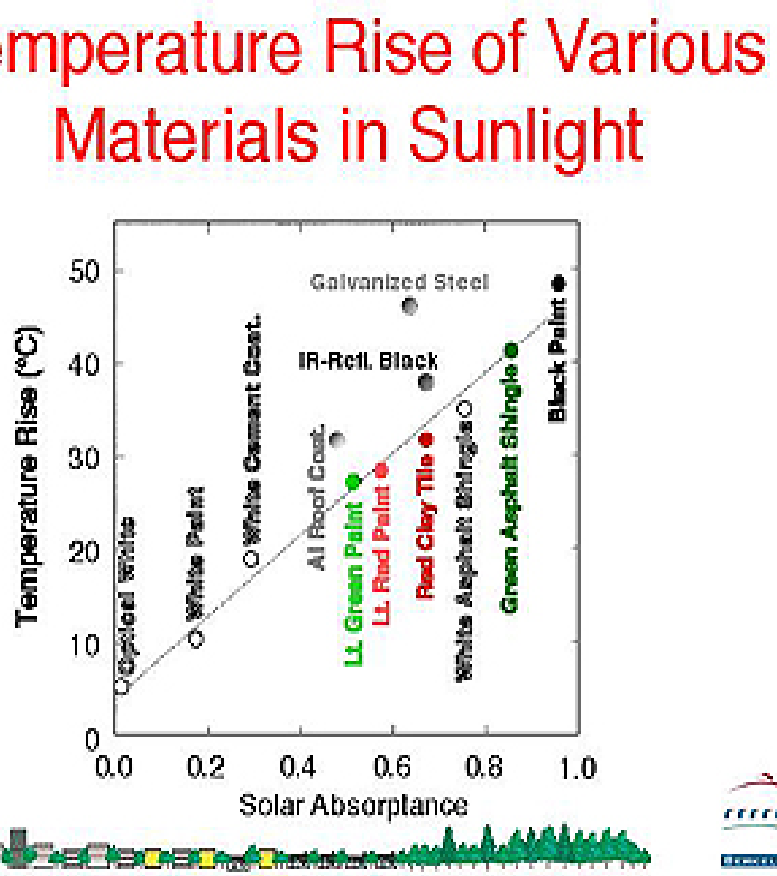
Sunshine duration	5 to 15% less
Annual mean temperature	0.5-1.0 °C higher
Winter maximum temperatures	1 to 2 °C higher
Occurrence of frosts	2 to 3 weeks fewer
Relative humidity in winter	2% lower
Relative humidity in summer	8 to 10% lower
Total precipitation	5 to 10% more
Number of rain days	10% more
Number of days with snow	14% fewer
Cloud cover	5 to 10% more
Occurrence of fog in winter	100% more
Amount of condensation nuclei	10 times more

London Heat Island



Marked differences in air temperature are some of the most important contrasts between urban and rural areas shown in the table above. For instance, Chandler (1965) found that, under clear skies and light winds, temperatures in central London during the spring reached a minimum of 11 °C, whereas in the suburbs they dropped to 5 °C. Indeed, the term urban heat island is used to describe the dome of warm air that frequently builds up over towns and cities.

Modifying the city surface albedo the key to eliminating UHI



1 HMG Response

2 Communities and Local Government Response

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And the Government is responding strongly on the domestic climate change agenda

- UK targets:
  - 12.5% reduction of greenhouse gases from 1990 baseline by 2008-2012 under Kyoto Protocol
  - Government target to reduce CO_2 by 20% by 2010; by around 30% by 2020; and goal of 60% by 2050
- Climate Change Bill:
  - establishes 2020 and 2050 goals as legal target;
  - sets 5-year "budgets" for emissions;
  - establishes advisory "Climate Change Committee";
  - contains enabling powers and provisions on reporting
- European Council set new EU targets for 20% reduction in CO_2 by 2020 (30% if we achieve international agreement) and 20% renewable energy target for 2020
- Energy White Paper will set out next steps

Communities and Local Government has a vital role in domestic climate action

- Our policies have huge influence on the **built environment** – through planning, building regulations and through the developments (e.g. Growth Areas) and social housing we support and fund

- **Local Government's** role is also key: (i) in shaping places; (ii) in leading the way and (iii) supporting community action e.g. Woking BC achieved 17% reduction in emissions across the borough; 77% across its own estate

Our response: a new Communities and Local Government Programme on climate change….

- ….Starting with new development

- Ruth Kelly proposal (December 2006) for progressive improvement in building regulations so that new homes will be zero carbon by 2016, with steps towards that in 2010 (25% improvement) and 2013 (44% improvement)

- This will be supported by
  - Stamp duty exemption for zero carbon homes (announced in PBR; details in Budget)
  - Code for Sustainable Homes
  - Planning Policy Statement on Climate Change

Starting with new homes

- Only 1% of the housing stock is new each year
- But nearly one third of the homes standing in 2050 will have been built between now and then
- Estimated savings of **7MtC** by 2050 (of 100MtC from buildings and 600MtC overall) – equivalent to combined total of the eight biggest cities outside London (including Birmingham, Manchester and Liverpool)
- **And policy levers are straightforward** (regulatory framework that bites, supported by voluntary Code and tax incentives for those who want to go faster)
- **Announcement of policy changes in advance** means certainty for industry. December's policy announcement made with support from Home Builders' Federation and WWF

Focus going forward

- **Existing homes**: Looking at improving energy efficiency in existing homes - the Hard Problem

- **Non-residential buildings**: New project aiming to set same type of long term challenge/ambition for commercial buildings as we have done already for new homes;

- **Growth Areas**: exemplar development, “Eco Towns” and Thames Gateway;

- **Local Government:** Local Government White Paper “an appropriate focus on climate change”…..Cities and Regions agenda;

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The Hard Problem,

70% of existing homes will be with us in 2050

With 100% reach to existing housing stock on four known fronts:

double glazing	loft and cavity wall insulation
condensing boilers	energy efficient appliances

BRE estimate that the carbon foot print of existing housing stock will be reduced by 20%.

(1) Where will the other 40% reduction come from? (And do not put all eggs in the one basket of decarbonising the energy supply.)

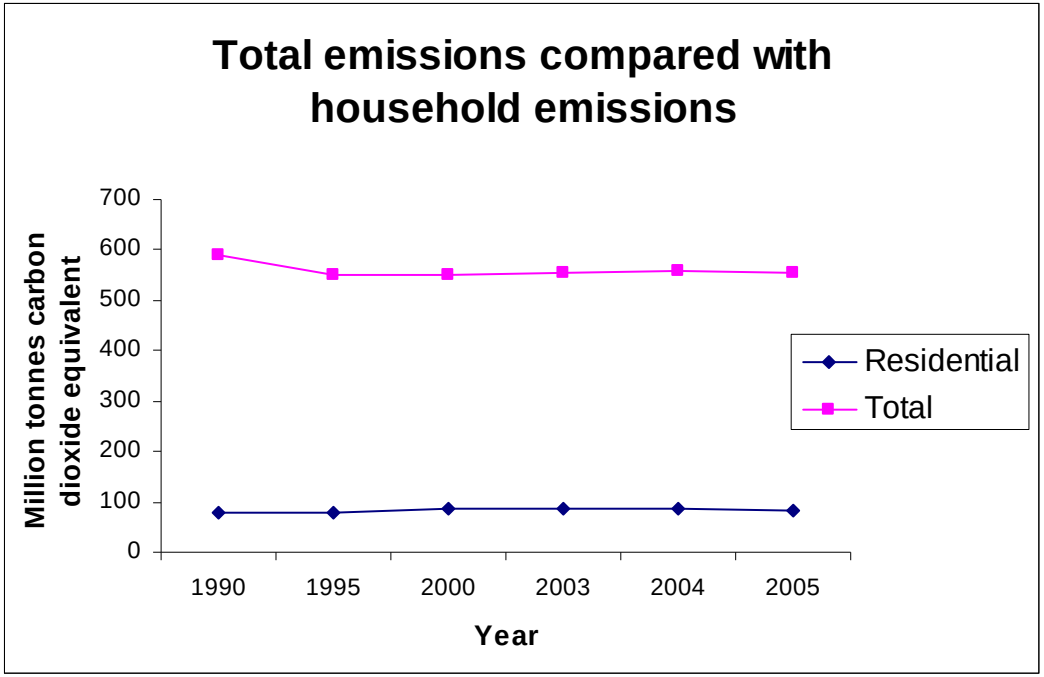
(2) How to get 100% reach when we only have 40% reach on loft insulation after decades of trying?

A key challenge for DCLG, DEFRA, HMG and ERP!

Existing homes are clearly a vital part of the picture

- Many policy instruments already in place designed to save energy in existing homes – Warm Front; Energy Savings Trust; Energy Efficiency Commitment; Decent Homes; Low Carbon Buildings Programme.

- And emissions from domestic sector actually fell last year by 4MtC. Weather versus policy instruments?



And it is clear there is a lot of potential in the existing stock…

- But clear that huge scope to implement cost-effective technologies remains – saving carbon and fuel bills

Box 1: Domestic Efficiency Measures – estimated costs & savings

Measures	Average cost (£)	Cost saved (£/yr)	Carbon saved (kgC/yr)	Pay-back (yrs)	Potential homes ('000) †	Potential total carbon saving (MtC/yr)
Hot water cylinder insulation	14	29	53	**0.5**	1,137	**0.1**
Cavity wall insulation	342	133	242	**2.6**	8,500	**2.1**
Loft insulation (full and top-up)	284	104	190	**2.7**	6,186	**1.2**
Improved heating controls	147	43	77	**3.4**	2,102	**0.2**
Draught proofing	100	23	43	**4.3**	9,793	**0.4**
Micro CHP	1,571	230	508	**6.8**	12,000[4]	**6.1**
Solid wall insulation	3150	380	694	**7.5**	7,479	**5.2**
A-rated boiler	1,500[1]	168	177	**8.9**	17,128	**3.0**
Micro wind	2,363	224	263	**10.5**	-[2]	-
Ground source heat pump[3]	4,725	368	990	**12.8**	17,000	**16.8**
Photovoltaic (PV) electricity	9,844	212	249	**46.4**	9,892	**2.5**
Solar water heating	2,625	48	88	**54.7**	19,330	**1.7**
Windows (Single to Double Glazing)	4,000[1]	41	26	**97.6**	10,746	**1.7**

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Other Initiatives

- Government looking at what more can be done to reduce emissions from existing homes.

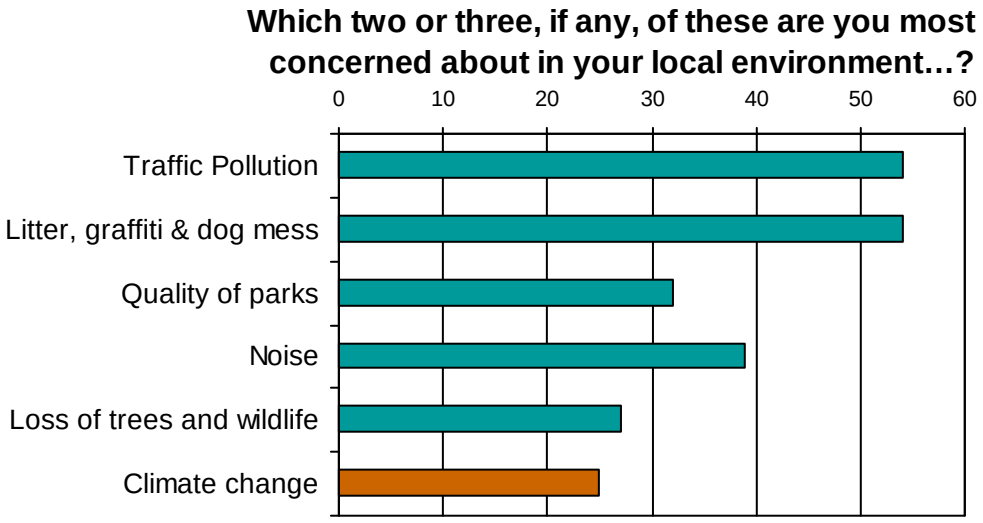
- Many initiatives, but punters still confused on what to do and where to get advice

- Non residential sector (18% of emissions – offices, retails, hospitality, public buildings….) needs approach similar to domestic homes – Greater variety of use and practice means greater challenge, but pushing at an open door.

- Again, public sector showing leadership is key – currently Sustainable Procurement Strategy committed to reduce carbon emissions from office based government estate by 12.5% by 2010 and 30% by 2020

And local government is a vital delivery partner

- Local government can have an enormous influence through place-shaping and community action – and on their own estate
- Huge variation in local government interest and performance. Some outstanding work in local government, e.g. Shropshire, Woking
- But Centre for Sustainable Energy constructed a matrix of local authority performance in 2005:
  - 41% Weak, 46% Fair, 10% Good and 3% Excellent
- Barriers to action include lack of focus in performance framework, lack of money, and perception that there are more immediate environmental issues to be tackled at local level



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Key Issues Going Forward

- Mitigation & Adaptation
- The Technology Chain
- Barriers, gaps incentives
- Roles of HMG, Industry and Research Community

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Mitigation

- Three steps to mitigate climate change in respect of energy usage:
  - Greater efficiency of production
    - including non-carbon sources
  - Greater efficiency of use
    - today's issues
  - Reduction in use
    - lifestyle issues

- In spite of 30 years of exhortation, grants etc, only 40% of loft space that could be insulated is insulated.

- We will have to take the public with us to succeed.

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Adaptation

- Summer heat more likely a problem than winter cold
- Learn lessons from Spain and California rather than Scandinavia
- Urban heat island a precursor scalable project
  London Olympics an exemplar?
- Water an interrelated issue and not to be ignored in any serious retrofit programme.

The Technology Chain

- Proven technologies – double glazing, insulation, efficient appliances and condensing boilers.

- Emerging Technologies – CHP, microgeneration, solar PV

- To be demonstrated technologies – intelligent house (heat and light only where and when needed), new cladding technologies (interior and exterior), …

- Unproven technologies – 'focussed microwave heating of occupants', radically new and intelligent materials

- Undiscovered technologies

- A technology trajectory roadmap is an early task for ERP

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Barriers, Gaps, Incentives

- Plethora of initiatives
- Simple and practical guidance
- Reach beyond middle classes
- Private rented accommodation
- Trained manpower for installation
- Social housing as exemplars

Respective Roles

- HMG
  - Set the playing field, policy and incentive framework
  - Beyond the Haldane principle – be an active collaborator in the national agenda rather than standing above
  - Work on exemplars – 100-1000 units at a time
  - VAT on improvements but not on new build
- INDUSTRY
  - Working with new build relatively easy
  - Repair sector notoriously unstructured
- RESEARCH COMMUNITY
  - Large long-term wins on decarbonising the primary energy source
  - Significant interim wins on new cladding and intelligent energy
  - Serious problem in configuring the end-user

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Building Materials

- A key role throughout the climate change and energy challenge
- No new or better materials implies missed targets
- Different materials and installation systems for new build and for retrofitting
- Intelligent materials
- Recycled materials
-

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The RD&D Agenda

We need to have the materials research integrated into a development and deployment plan to upgrade the energy efficiency of new and old buildings at the outset, not bolted on after the research is done as a discontinuous exercise.

Do we have the background calculations that show what known materials combinations can deliver in terms of thermal stability, maintaining thermal gradients, etc?

A Knowledge Integration Community around the energy efficient retrofitting?

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Conclusion

The slow-fast paradox of climate change

Materials development timescale is well suited to meeting the challenge of energy efficient buildings

Buckingham Palace, Bath Crescent and Balham a greater much challenge than Northstowe or the Olympic Village.

Integrated action more likely to succeed

Skilled retrofitters are in very short supply, so can ease of installation be a focal point of new systems R&D?