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Delivering End Use Energy Demand reductions in buildings – challenges and opportunities

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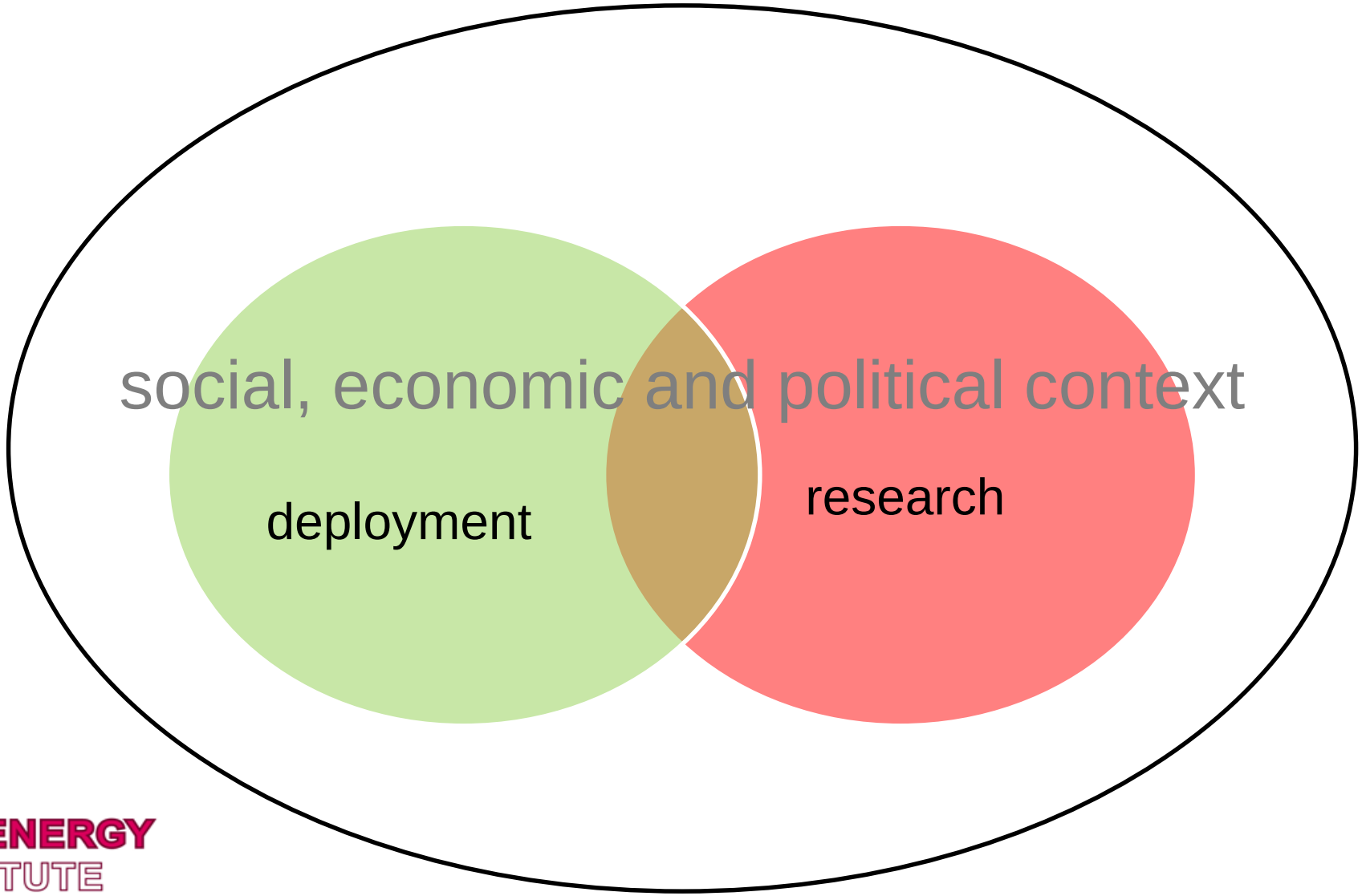
UCL-Energy Institute

UK-Japan Collaboration – The Past and Future Earth

4th March 2016

the landscape



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the reduction of energy demand is widely seen as a key strategy for meeting climate change objectives:

- reducing rates of change needed on the supply side
- harnessing multiple independent supply chains
- reducing whole system costs
- improving resilience

the reduction of energy demand is widely seen as a key strategy for meeting climate change objectives:

> Only a limited number of studies have explored emissions pathways consistent with limiting long-term temperature change to below 1.5° C in 2100 relative to pre-industrial times. In these scenarios, temperature peaks over the course of the century and is brought back to 1.5° C with a likely chance at the end of the century. These scenarios assume immediate introduction of climate policies as well as the rapid upscaling of the full portfolio of mitigation technologies ***combined with low energy demand*** in order to bring concentration levels below 430 ppm CO_{2eq} in 2100.
>
> (IPCC AR5 WGIII SPM & Technical Summary, p56. Emphasis added.)

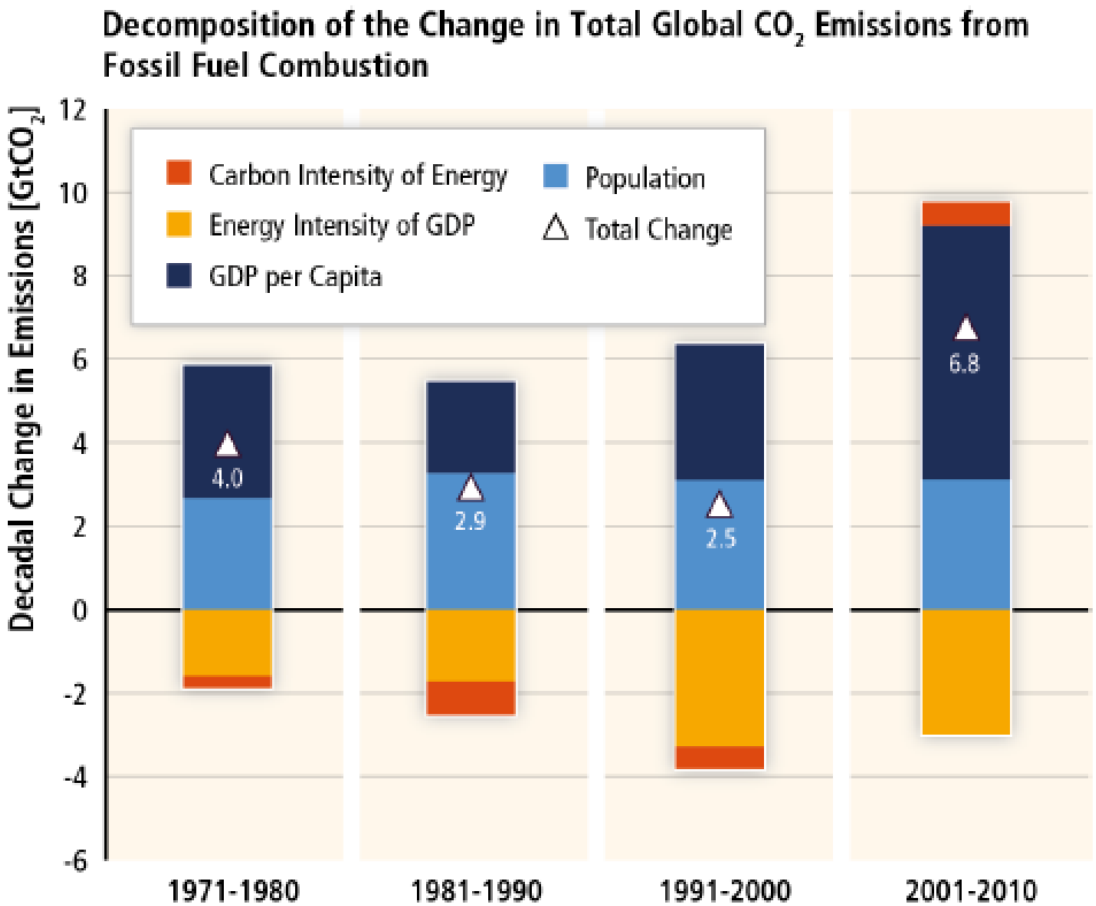

Figure TS.6. Decomposition of decadal absolute changes in total CO_2 emissions from fossil fuel combustion by Kaya factors: population (blue), GDP per capita (red), energy intensity of GDP (green) and carbon intensity of energy (purple). Total decadal changes in CO_2 emissions are indicated by a black triangle. Changes are measured in gigatonnes of CO_2 emissions per year (Gt/yr). [Figure 1.7]

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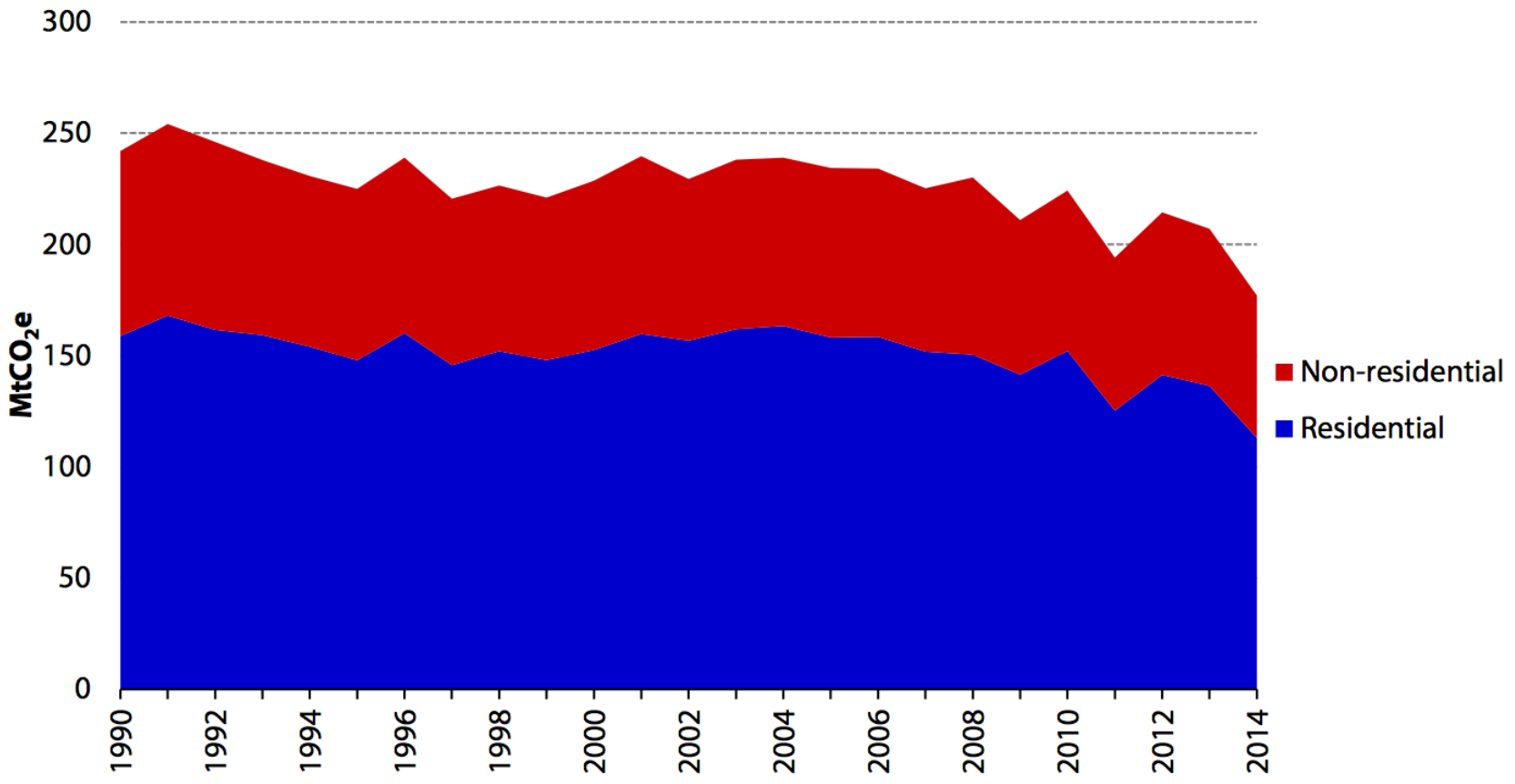
(IPCC AR5 WGIII Technical Summary, p48.)

the reduction of energy demand is widely seen as a key strategy for meeting climate change objectives:

> Energy efficiency and behaviour change. Reducing the level of energy demand through improved efficiency and small changes to consumer behaviour can greatly reduce the cost of meeting the 2050 target. However, it is clear that this alone will not be enough to reduce emissions by 80%, and fuel switching to low-carbon sources will also be needed.
>
> (CCC 2015 The Fifth Carbon Budget: Next step towards a low-carbon economy. p56.)

Figure 3.2: Historical buildings emissions (direct and indirect) since 1990



Source: NAEI (2015), DECC (2015) *Energy Trends, March 2015*, DECC (2014) *DUKES*; CCC calculations
Notes: 2014 emission estimates are provisional.

the reduction of energy demand is widely seen as a key strategy for meeting climate change objectives:

> Mobilising energy efficiency is an urgent priority. To transition to the sustainable energy system of the future, we need to decouple economic growth from greenhouse gas (GHG) emissions. Energy efficiency is the most important “arrow in the quiver” to achieve this.
>
> (IEA 2015 Energy Efficiency Market Report. p.3)

the reduction of energy demand is widely seen as a key strategy for meeting climate change objectives:

> Buildings are a large and growing market for energy efficiency Global energy efficiency investment in buildings is estimated to have been USD 90 billion (+/- 10%) in 2014. Of the approximately USD 960 billion spent in the residential and commercial building construction market in the United States in 2014, 2.4% (ie. more than USD 23 billion) was invested in energy efficiency, up from 1.9% in 2009. In the People's Republic of China, energy efficiency investments in buildings exceeded USD 18 billion, with more than 60% invested in the residential sector. In Germany, energy efficiency investments exceeded USD 17 billion with 75% directed towards residential buildings and more than 60% targeting energy efficiency retrofits.
>
> (IEA 2015 Energy Efficiency Market Report. p.18)

but…

the performance gap and its origins

lack of feedback

barriers to learning

potential for unintended and perverse outcomes

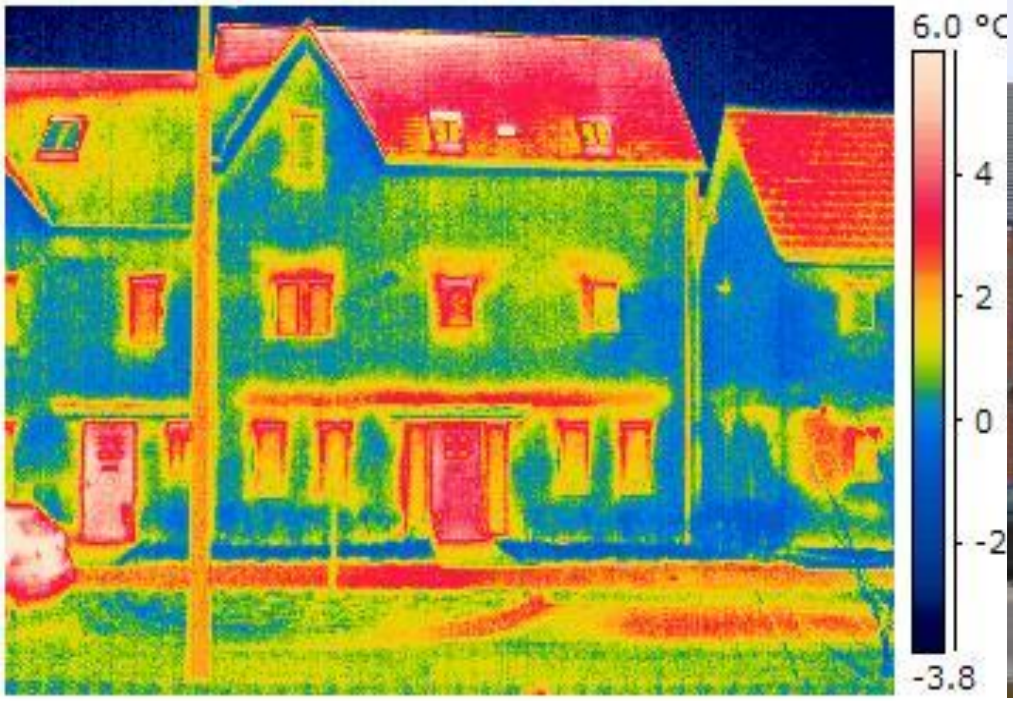
the rollercoaster of research funding

the performance gap

- evident at all levels in building energy performance
  - elemental performance – measured U values up to twice as high as predicted
  - whole building heat loss
  - energy use of occupied building
- technical underperformance is pervasive, historically underestimated, rarely measured and often conflated with rebound
- systems for both predicting and measuring performance as part of the regulatory process are themselves subject to significant quality issues

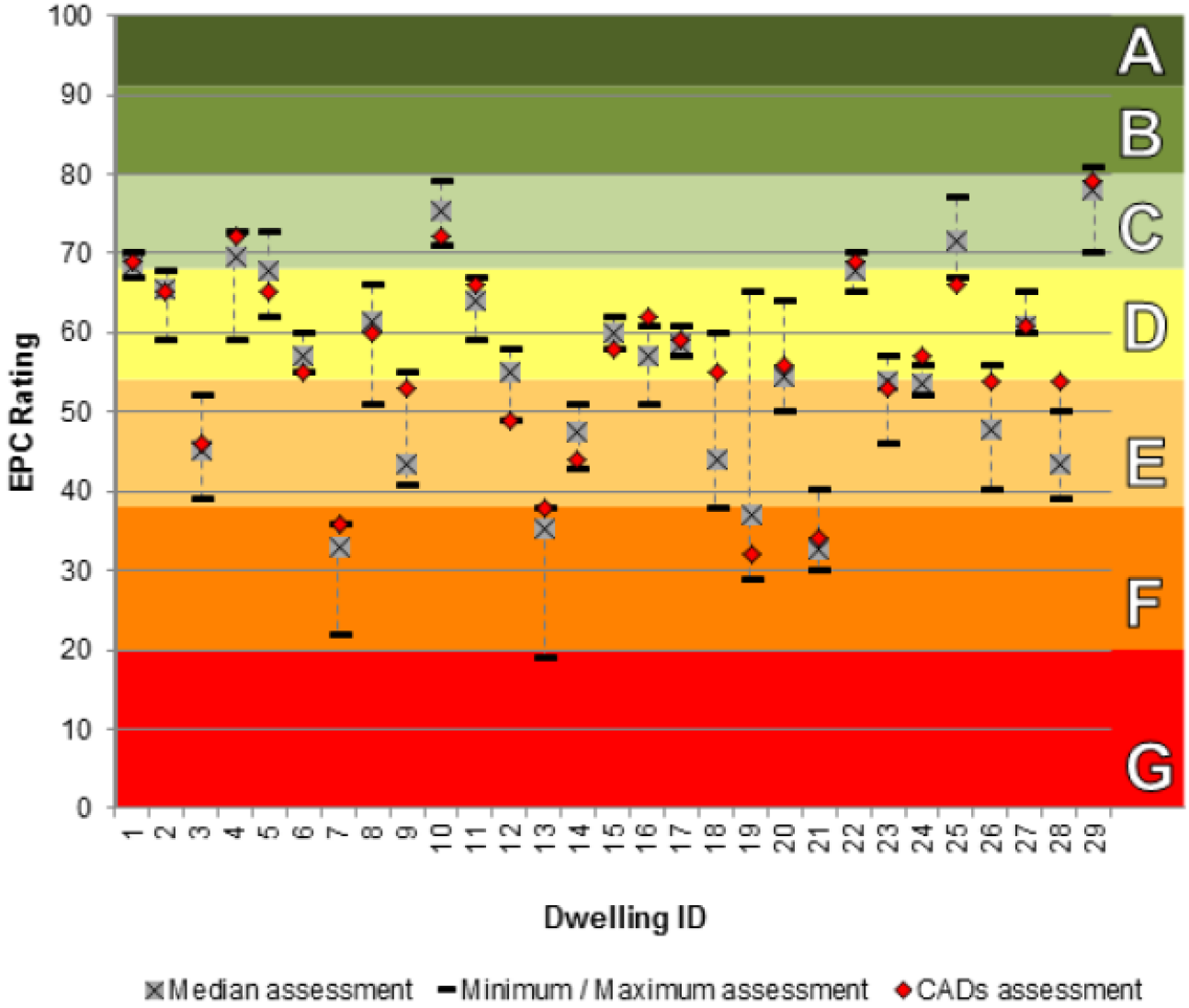
Stamford Brook – thermal envelope defects

www.leedsmet.ac.uk/as/cebe/projects/stamford/summary.htm



failures of energy demand reduction measures in buildings…

confidential report by Rockwool for BBA



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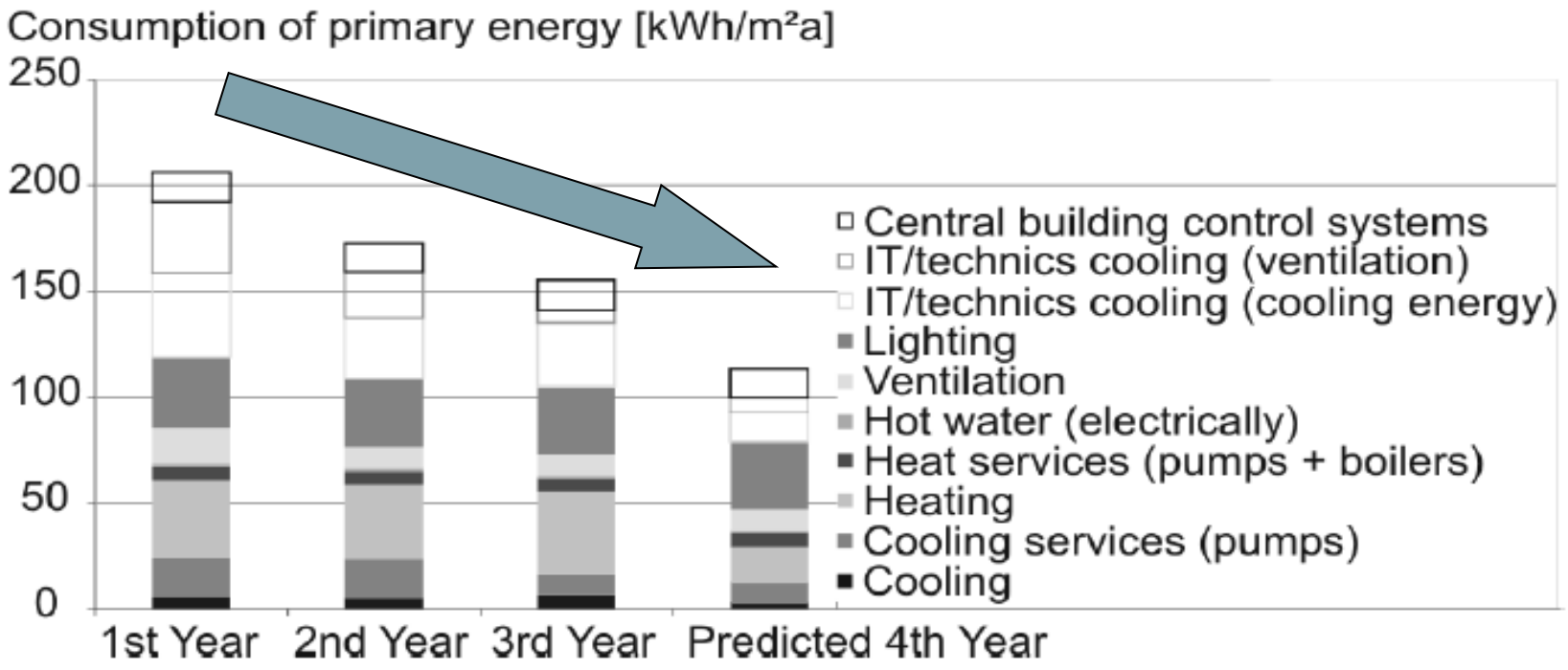
DECC 2014 Green Deal Assessment – Mystery Shopping Research.

the importance of feedback - experience at KfW

(Kleber & Wagner 2007)



lack of skills to support monitoring and feedback

"For me, the most interesting outcome was not the official one, which was that an alert, motivated design team could save 50% of the energy with a reasonable payback time, but was how hard it was to find any competent design team and any competent "third party" to do the measurement and verification."

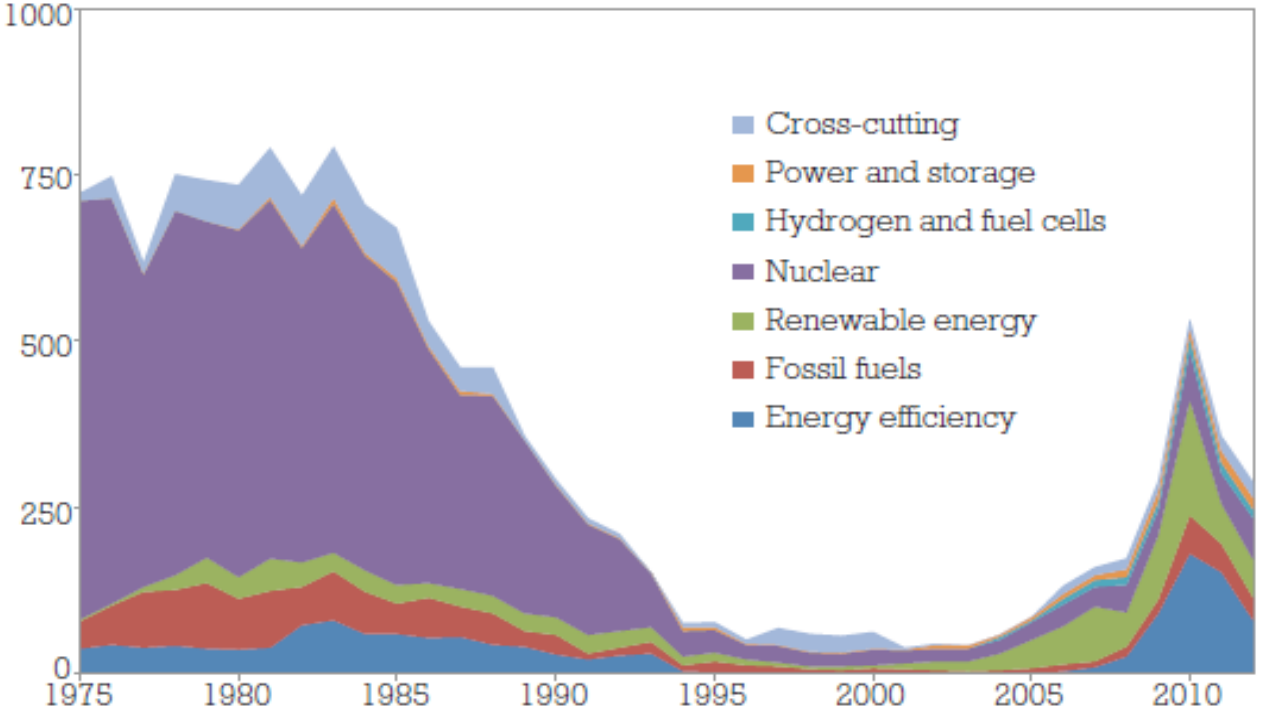
Art Rosenfeld (1999) The Art of Energy Efficiency: Protecting the Environment with Better Technology, *Annual Review of Energy and the Environment*, 24:33-82.

barriers to learning

- lack of communication within the supply chain
- lack of reliable data on performance from regulatory processes or in academic literature
- structure of industry
  - multiple layers of contracting
  - boom and bust
  - perverse incentive structures
  - fragmented building control

the rollercoaster of research funding…

Figure 10: UK Annual Public Sector RD&D Budgets (£m, 2012 money)



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how can we improve the situation?

- improved feedback on performance at all levels
- recognition of industry structures as drivers of quality and learning
- improved training and certification
- avoidance of perverse incentive structures

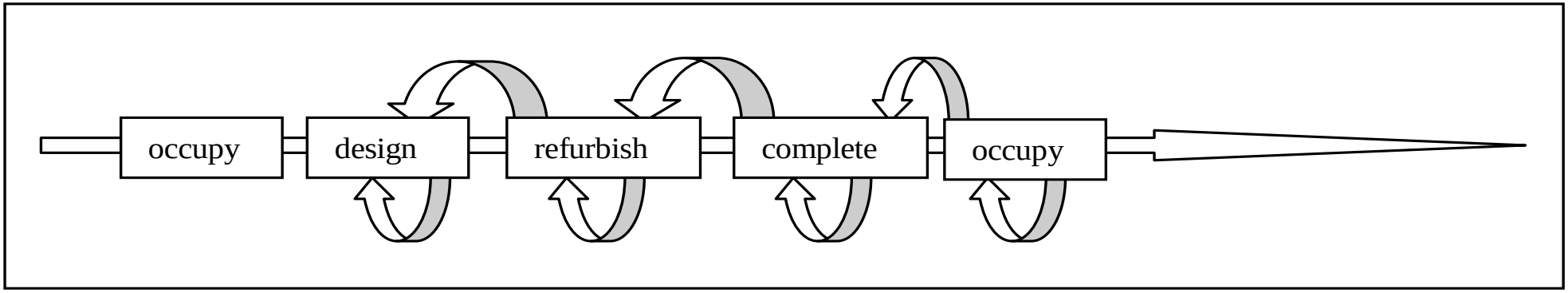
research in a time of transition

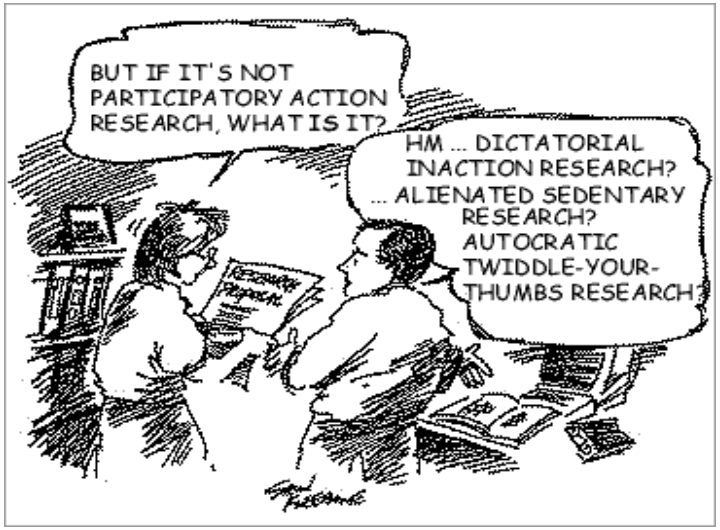
- building tools or seeking answers?
- understanding the world or helping to change it?
- improving models or improving practice?
- emphasising innovation or deployment?

- energy in buildings research depends strongly on industry, policy and energy supply context
- rates of change in policy domain likely to exceed what conventional research can keep up with
- to remain relevant, research needs to engage with the processes of transition, rather than sitting outside trying to take snap shots
- and to recognise the socio-technical origins of energy demand

using new research strategies…

Small loop learning – reflection *in* and *on* action at site/company level





http://www.research-for-real.co.uk/images/cartoon_02.gif

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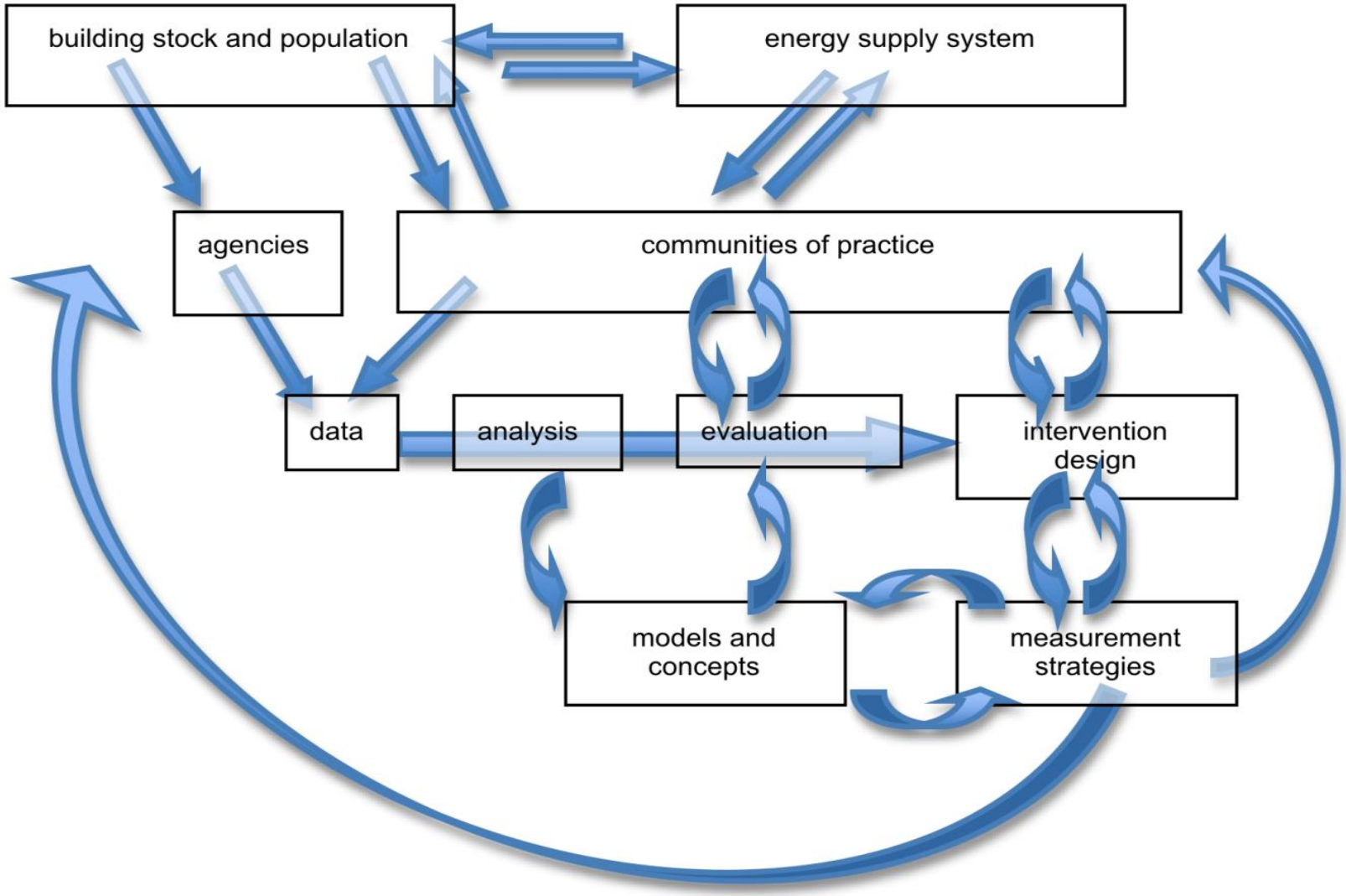

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Thank you!

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