

# UCL ENERGY INSTITUTE

Transforming existing building stocks:  
reflections on UK experience of energy efficient  
retrofit

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## outline...

- hopes and expectations
- reality
- mechanisms and drivers for poor outcomes
- the way forward.

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

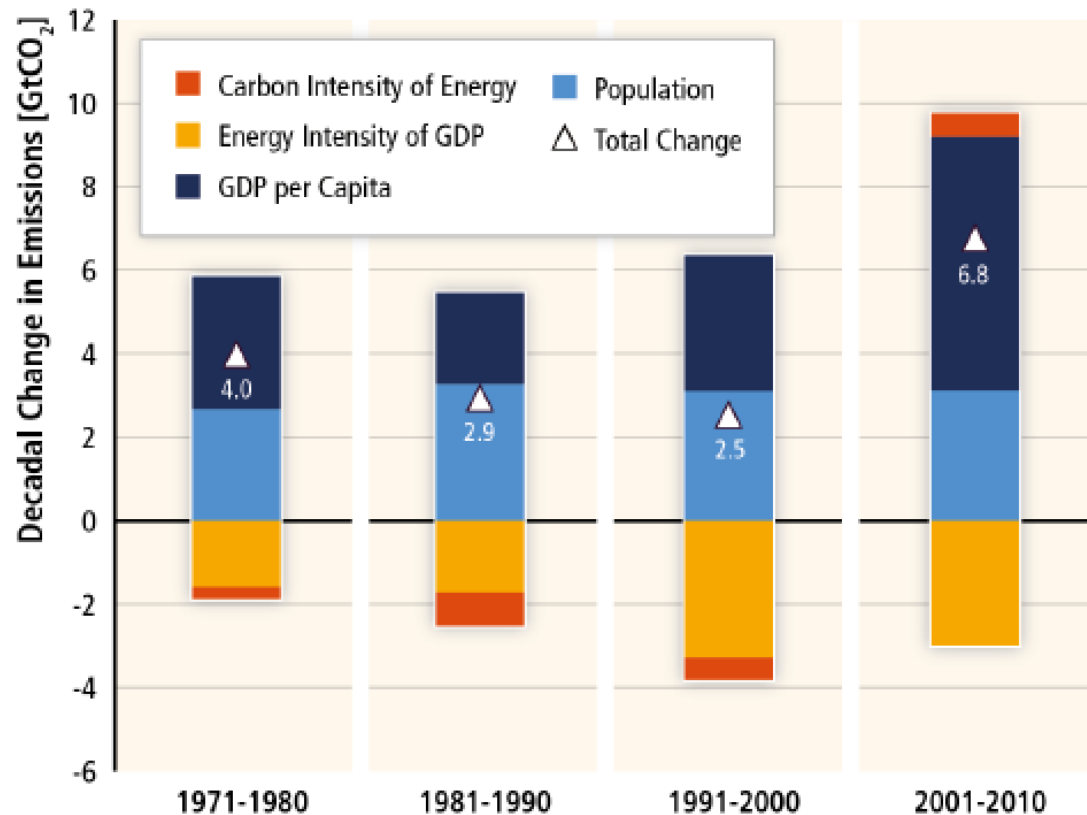
- reducing rates of change needed on the supply side
- harnessing multiple independent supply chains
- reducing whole system costs
- improving resilience.

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<sub>2eq</sub> in 2100.

(IPCC AR5 WGIII SPM & Technical Summary, p56. Emphasis added.)

Decomposition of the Change in Total Global CO<sub>2</sub> Emissions from Fossil Fuel Combustion



**Figure TS.6.** Decomposition of decadal absolute changes in total CO<sub>2</sub> 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<sub>2</sub> emissions are indicated by a black triangle. Changes are measured in gigatonnes of CO<sub>2</sub> emissions per year (Gt/yr). [Figure 1.7]

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.)

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

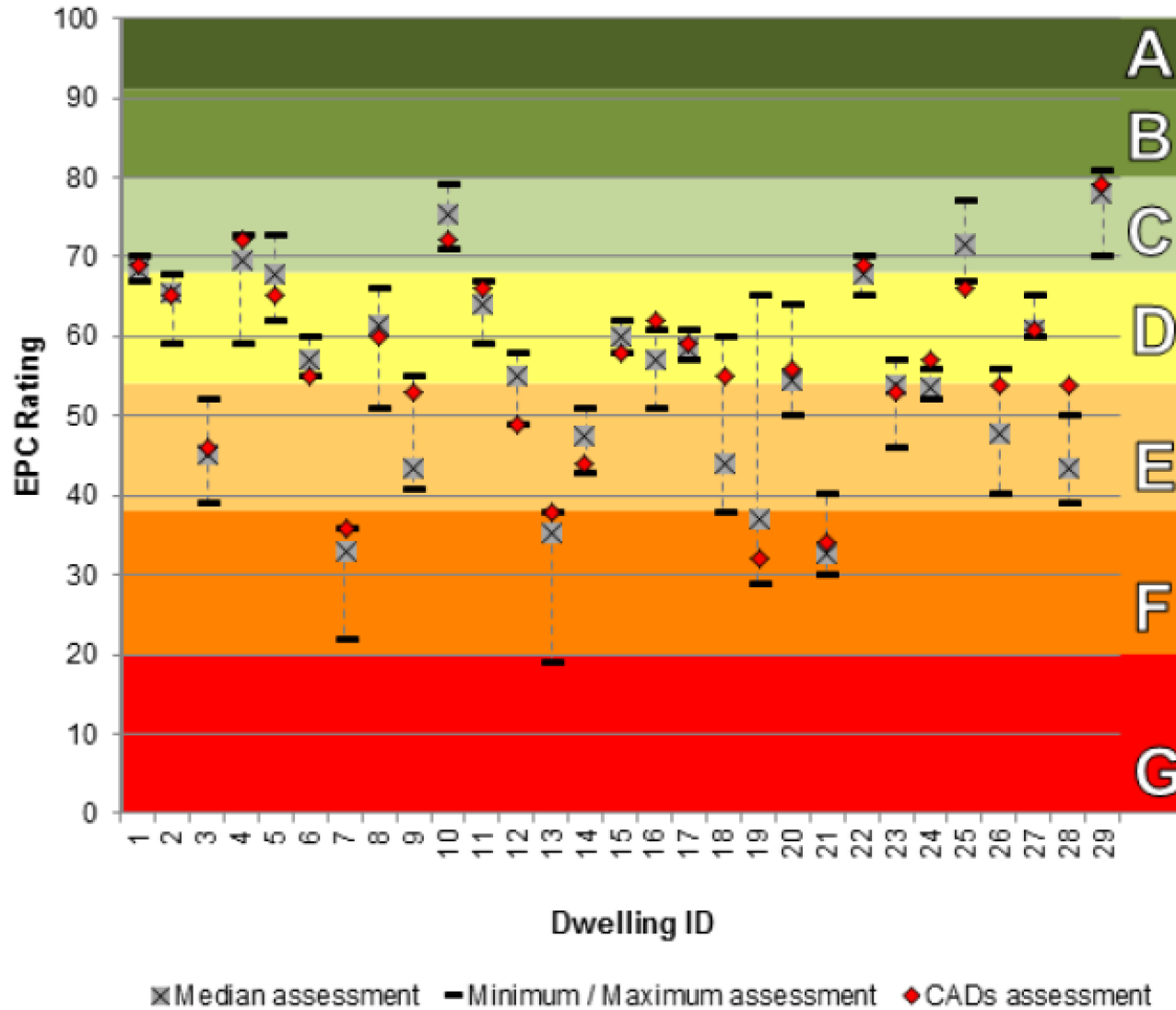
barriers to learning

the role of structure

potential for unintended and perverse outcomes.

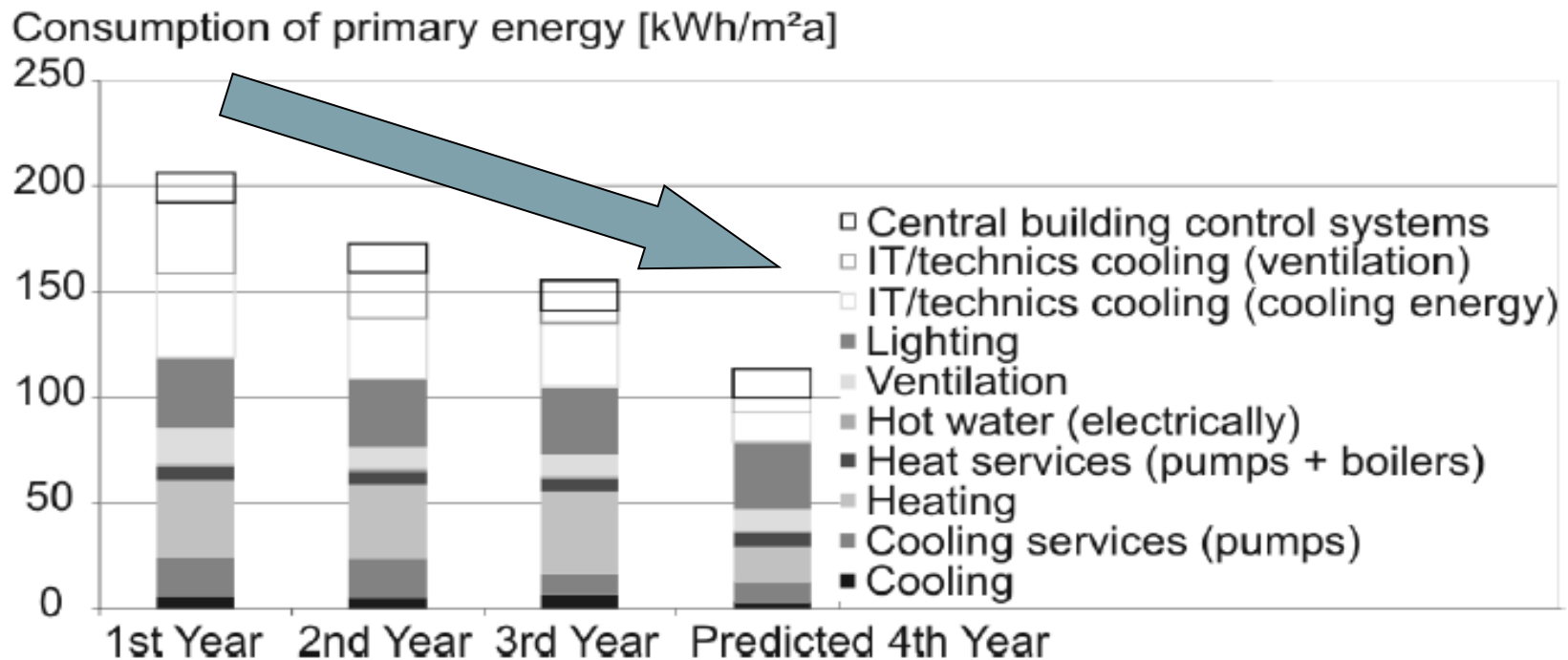
## the performance gap

- 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.



# the importance of feedback - experience at KfW

(Kleber & Wagner 2007)



but...

“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.

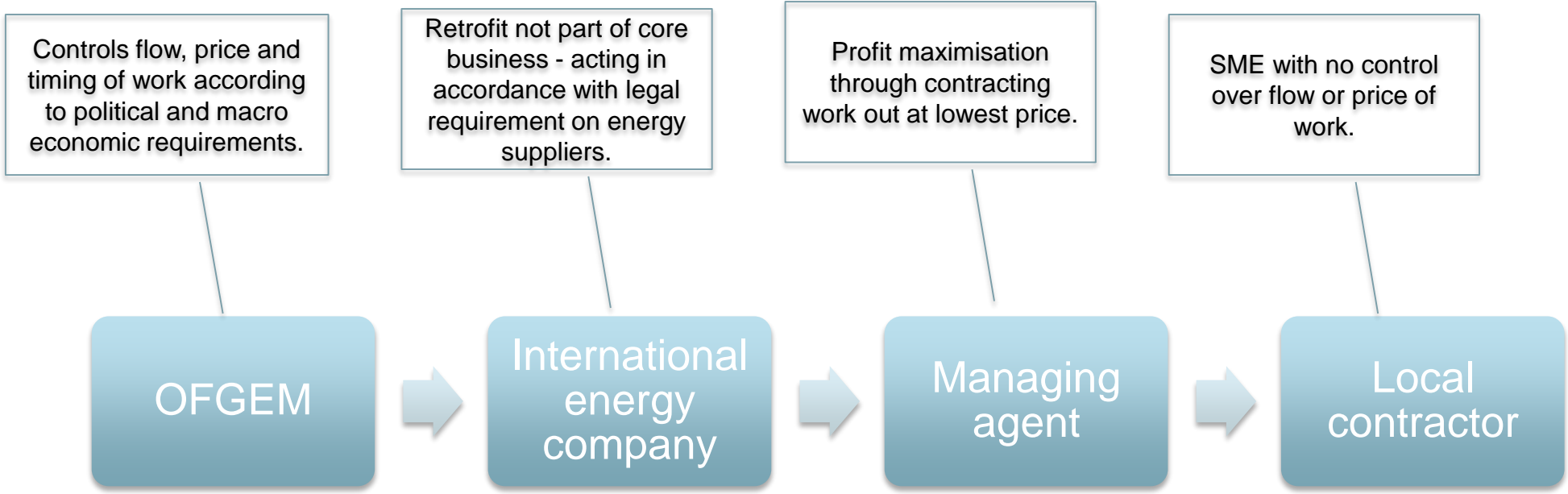
# failures of energy demand reduction measures in buildings...



# failures of energy demand reduction measures in building



# structure of the supply chain...





## 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

## political and policy coherence

- the deployment window for the energy infrastructure of the 2050's is shorter than the time needed for the unplanned economy to converge on, and implement solutions
- planning is therefore an unavoidable part of the solution, but
- weakness market mechanisms, and
- incoherence and churn in the political sphere prevent the establishment of robust, high quality supply chains

## how can we improve the situation?

- recognition of industry and programme structures as key drivers of quality and learning
- avoidance of self-inflicted boom and bust
- progressive replacement of command and control programme management with market-based mechanisms
- avoidance of perverse incentive structures
- improved feedback on performance at all levels.

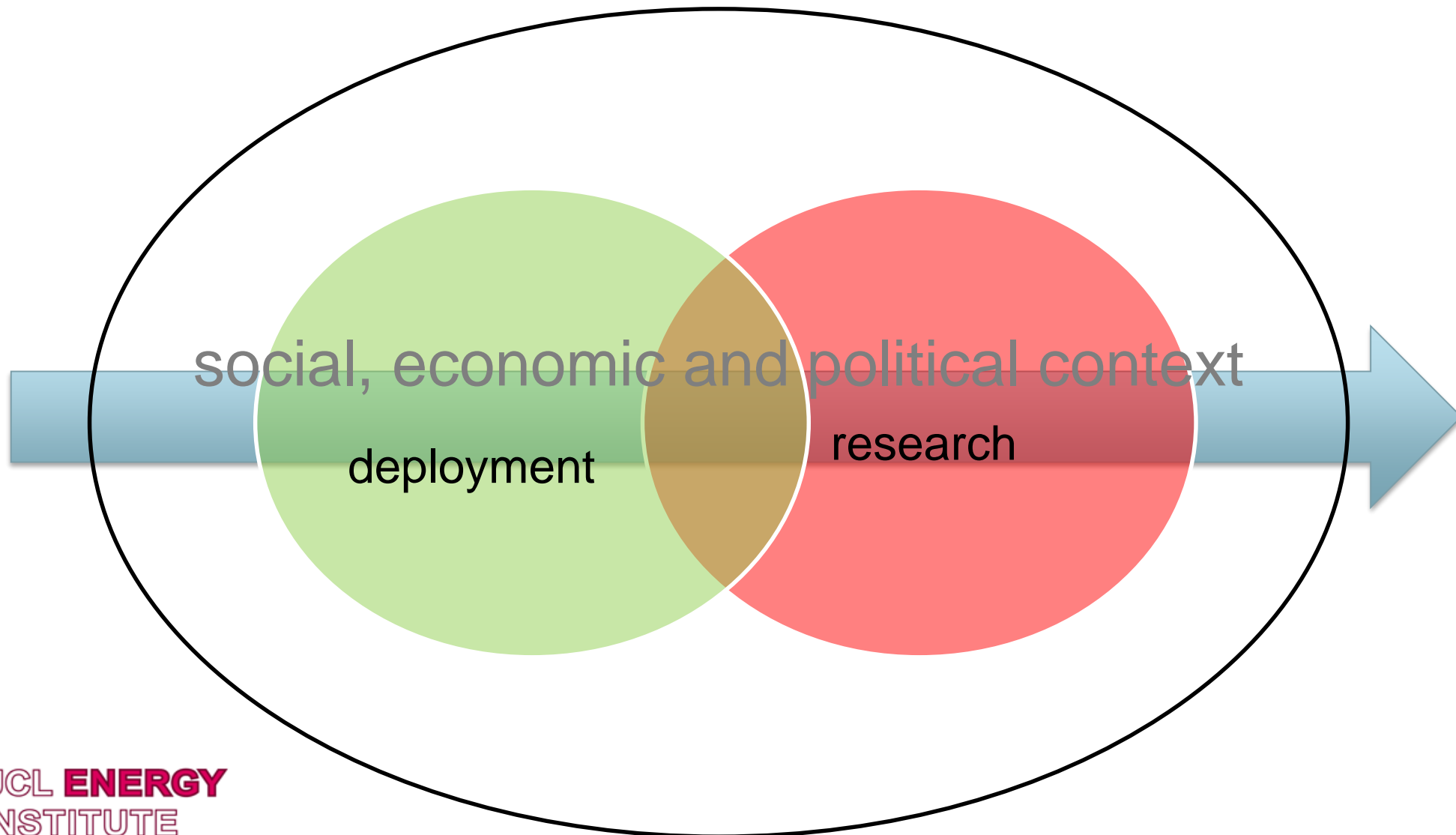
how can we improve the situation?

- over-arching need for inter-decadal political and policy coherence

## research in a time of transition

- need for a socio-technical perspective and inter-disciplinary teams that are capable of revealing incentive structures, and motivations of actors within supply chains
- need to undertake research *in* and *on* the deployment of existing technologies.

# research in a time of transition



## acknowledgements

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**Thank you!**



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