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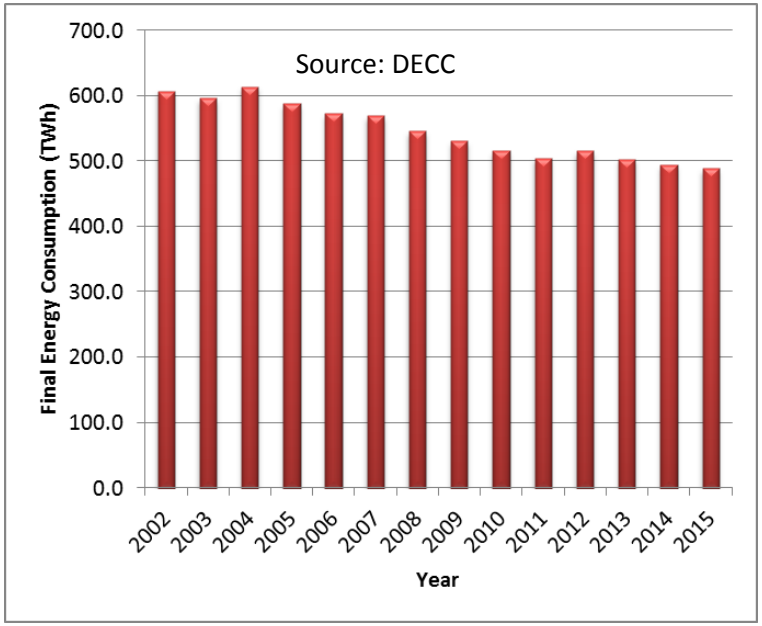
ENERGY EFFICIENCY IN BUILDINGS:
BRIDGING THE "PERFORMANCE GAP"

NICK KELLY, ENERGY SYSTEMS RESEARCH UNIT

THE PERFORMANCE GAP

- built environment energy efficiency has been improving
- however energy performance often falls short of what was anticipated
  - higher energy consumption than anticipated (buildings)
  - poorer energy performance (technologies)
  - poor quality indoor environment (buildings)
- gap needs to be addressed if radical GHG reductions are to be achieved
- … and we provide high quality indoor environment



Dunoon Passive Houses; image e-Architect

PERFORMANCE GAP: BUILDINGS

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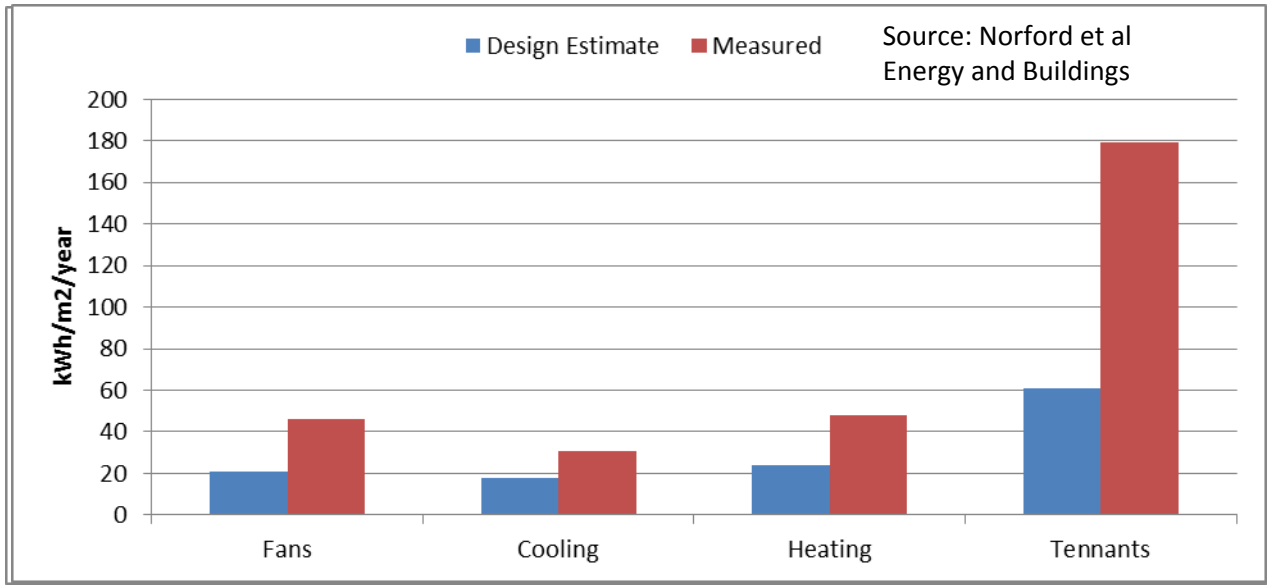
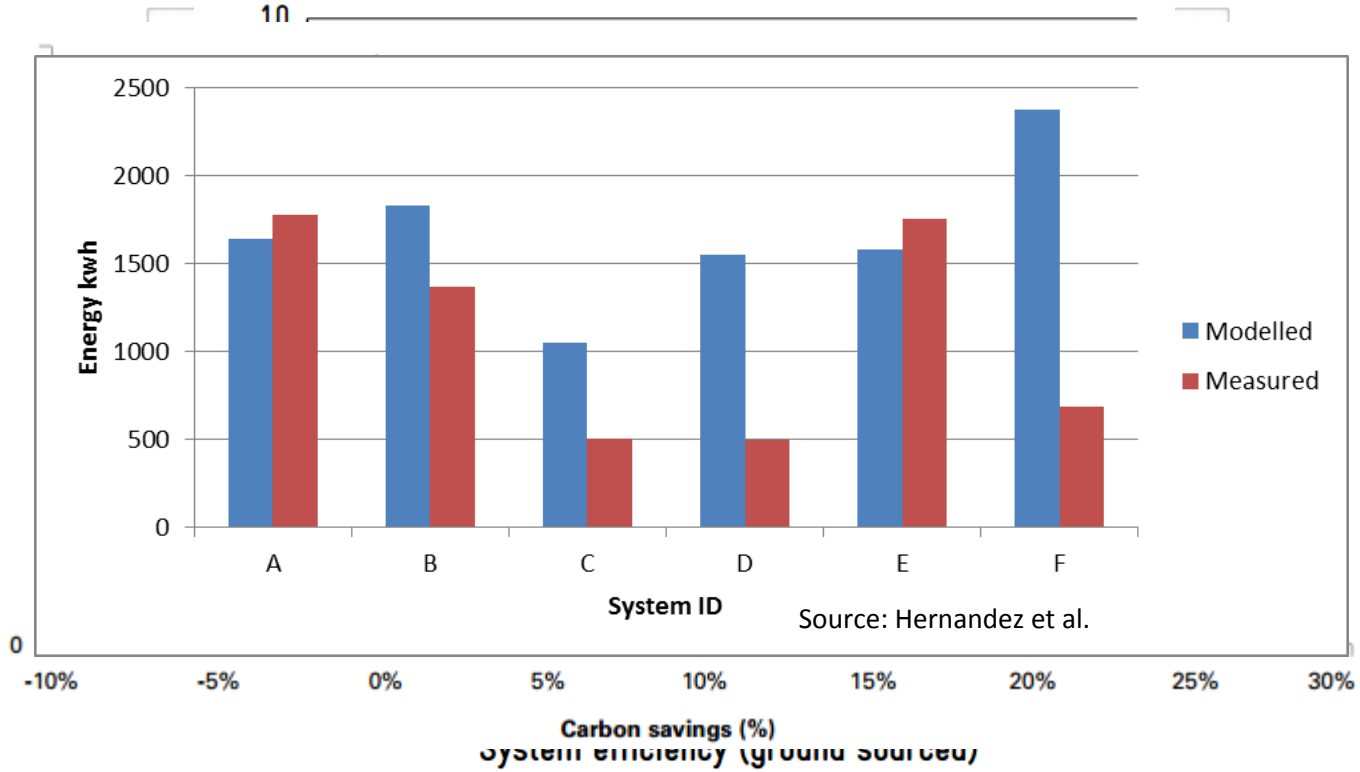
- UK studies (and elsewhere) such as PROBE (1995-2001) indicate poorer in use performance than intended



PERFORMANCE GAP: TECH.

- Individual technologies have also failed to perform as expected: micro wind, heat pumps, micro CHP, solar thermal …



Source: Hernandez et al.

PERFORMANCE GAP: WHY?

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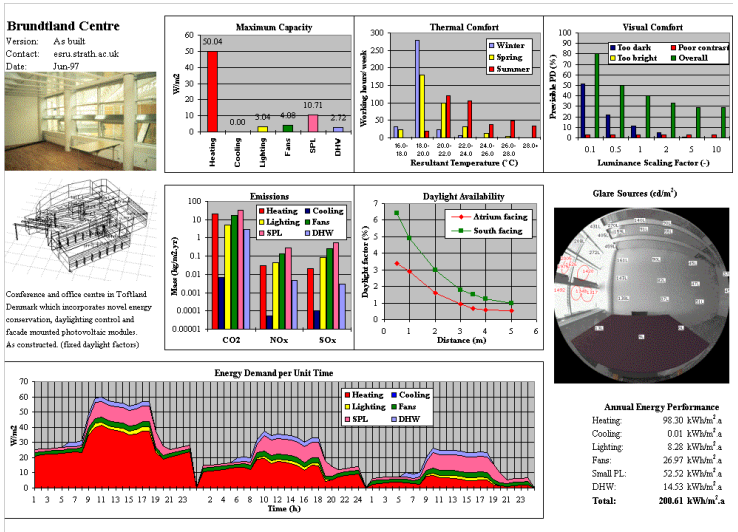
Source: de Wilde, Automation in Construction 41

Design	Construction	Operation
Poorly communicated performance targets	Post modelling and on-site design changes (e.g. value engineering)	Building use different from design intent
Lack of clarity on building use	Poor quality work (air tightness, thermal bridging, missing insulation, etc.)	Operational performance of equipment lower than manufacturer's published data (e.g. PV)
Lack of focus on performance and end users	Minimal or no commissioning of systems and control	Building occupancy (numbers, timing) different from that specified at design stage
Poor models (oversimplification, inaccuracy)		Interference with controls settings
Poor model data		Energy inefficient behaviour
Poor use of models (skills)		Degradation of systems and materials
Over specification of equipment		Lack of performance monitoring

PERFORMANCE GAP: TOOLS



- underpinning model quality e.g. steady state, partially dynamic, fully dynamic, 1-D, 3-D
- supporting data: weather, materials, geometry, set points, occupancy, equipment levels, equipment use, operating hours …
- validation against broad range of real building types

- lack of knowledge/skills: data input, output verification, incorrect selection of tool features, etc.

PERFORMANCE GAP: HIGH QUALITY

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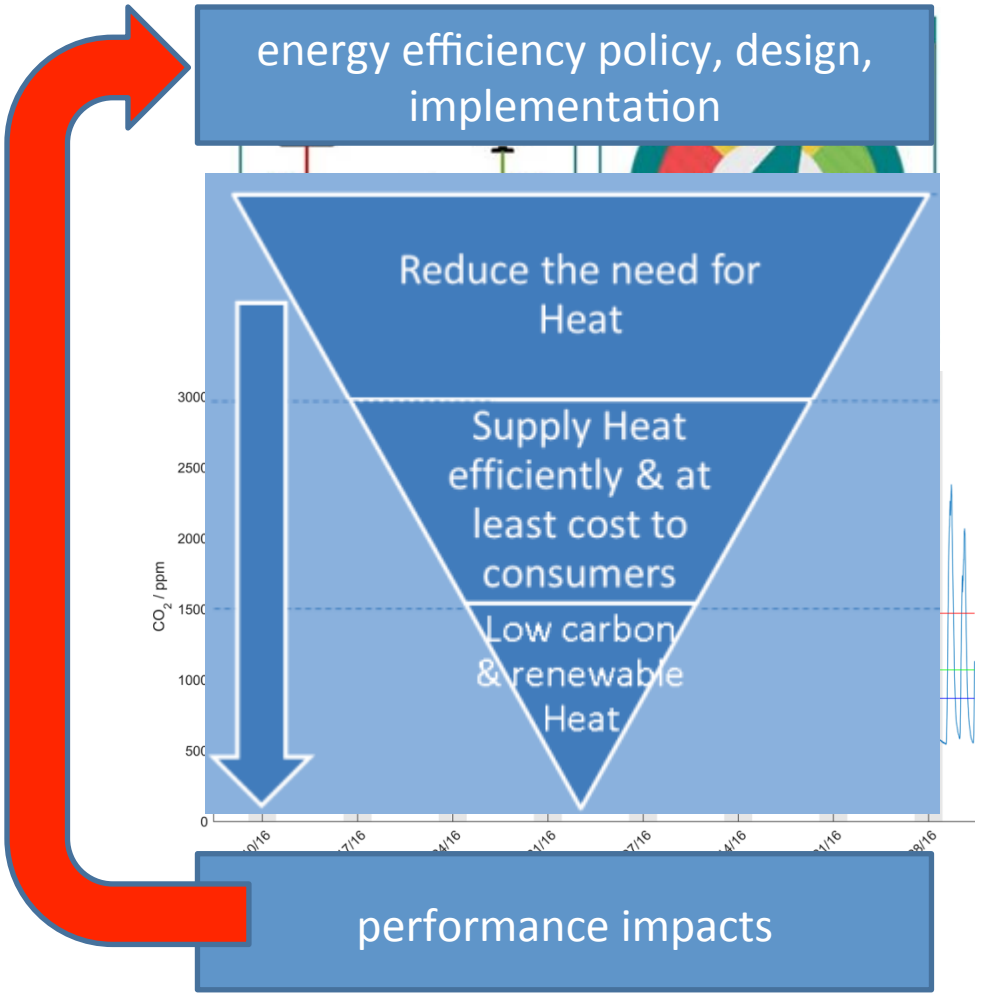
- Passivhaus requires super insulated fabric, elimination of thermal bridging, airtight + MVHR
- requires far more stringent quality of construction and quality control (building and systems)
- step change required in skills *and* processes
  - e.g. off site construction
  - full commissioning
  - quality control

PERFORMANCE GAP: DID IT WORK?

- it is still rare that real building performance is compared to original estimations
- yet vital
  - to gather data on real building behaviour
  - assess impact of policy measures
  - and also improve the quality of models (verification and base data)
- requires that the performance of buildings are suitably monitored – meter reading tells us little about overall performance
- performance NOT just energy – temperatures, indoor air quality, noise levels, light levels



CONCLUSIONS

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Questions

nick@esru.strath.ac.uk

www.strath.ac.uk/esru

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Strathclyde
Glasgow