CIBSE Building Simulation Group

‘Compliance vs Performance’ – A Tale of Two Cities

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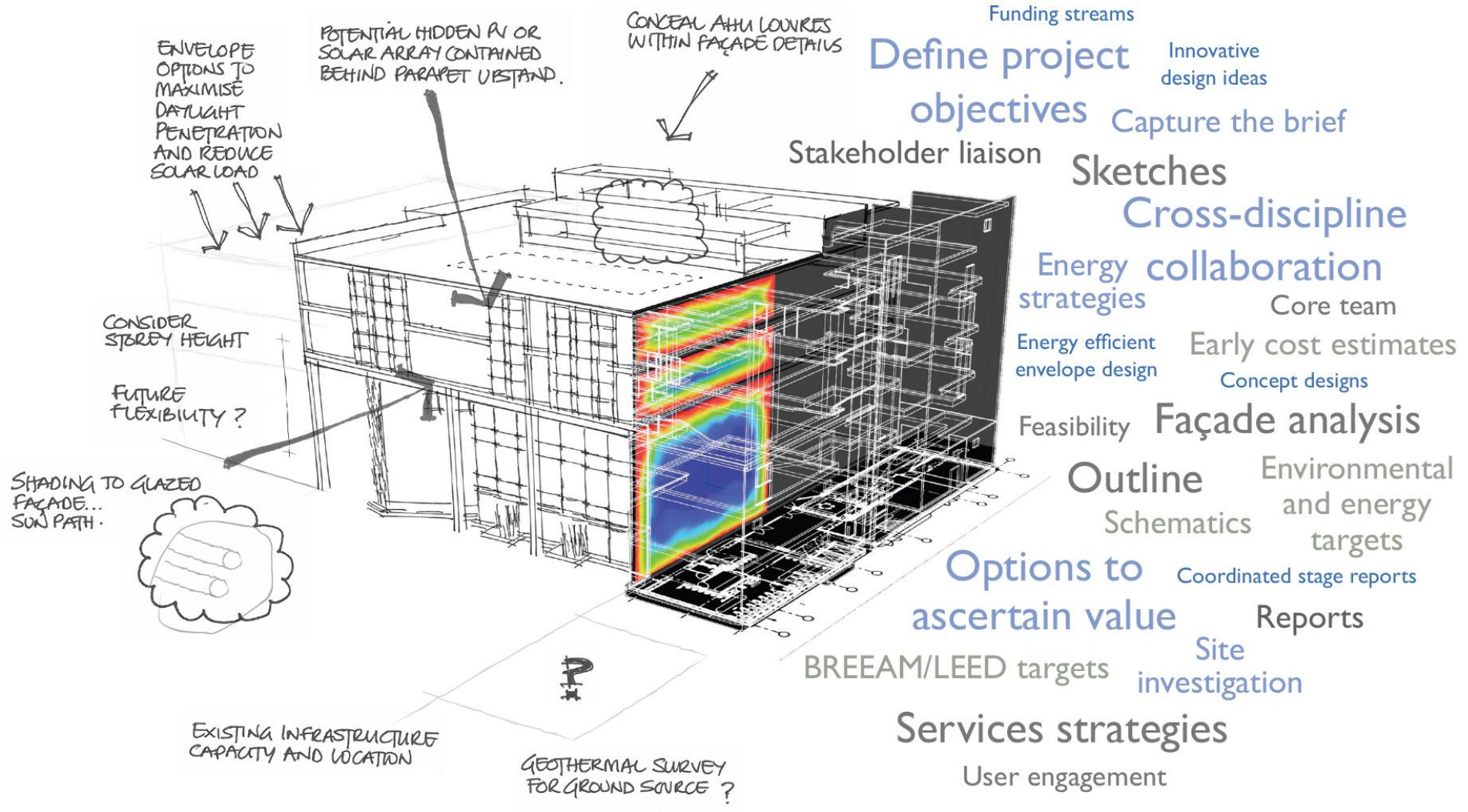
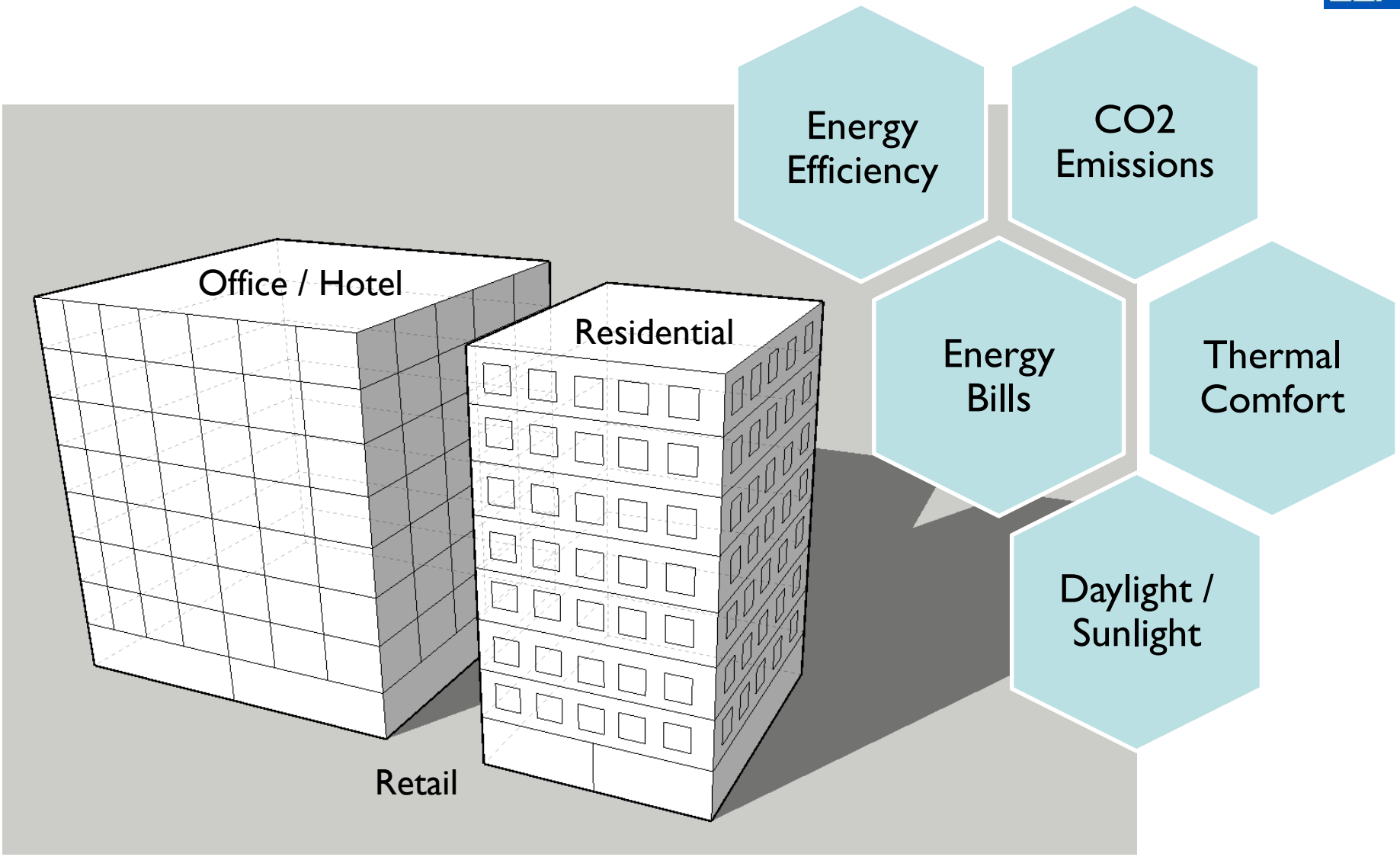
23 May 2017

'Compliance vs Performance' – A Tale of Two Cities…



What are we typically designing for?



What are the drivers?

Environmental challenges for future buildings

- Climate Change
- Energy efficiency / Fuel Poverty
- Performance gaps
- Thermal comfort / overheating risk
- Air quality
- Health and wellbeing

Energy Efficiency

‘Compliance’ Approach?

- Building Regulations Part L
- SAP, NCM, EPCs
- Planning Policy Targets (CO_2 / Renewables)

‘Performance’ Approach?

- CIBSE TM54 - Evaluating Operational Energy Performance of Buildings at the Design Stage
- Passivhaus
- NABERS

Health & Wellbeing / Occupant Comfort

‘Compliance’ Approach?

- Daylight / Sunlight report for planning
- Part L - Criterion 3 (Design Stage and As Built)
- Overheating assessment for planning

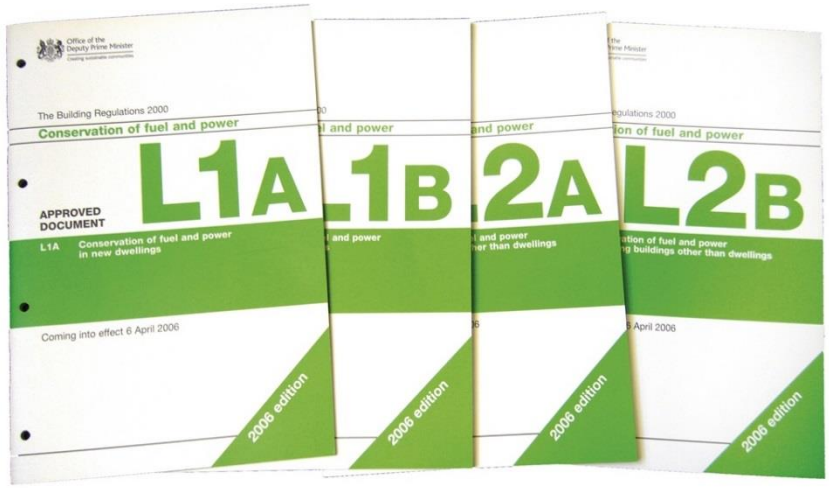
‘Performance’ Approach?

- Consideration of Daylight throughout design, potentially inc. Climate Based Daylight Modelling
- Dynamic Thermal Simulation of Thermal Comfort (Operative Temp, PMV / PPD)
- Dynamic Thermal Simulation of Overheating Risk (CIBSE TM52, TM59)

‘Compliance’ Approach / Tools

Part L of the Building Regulations

- Conservation of Fuel and Power
- Statutory Requirement
- Minimum Standards
- "Regulated" Energy only
- One Size fits all
- Five Criteria
- 'Design Stage' and 'As Built' checks



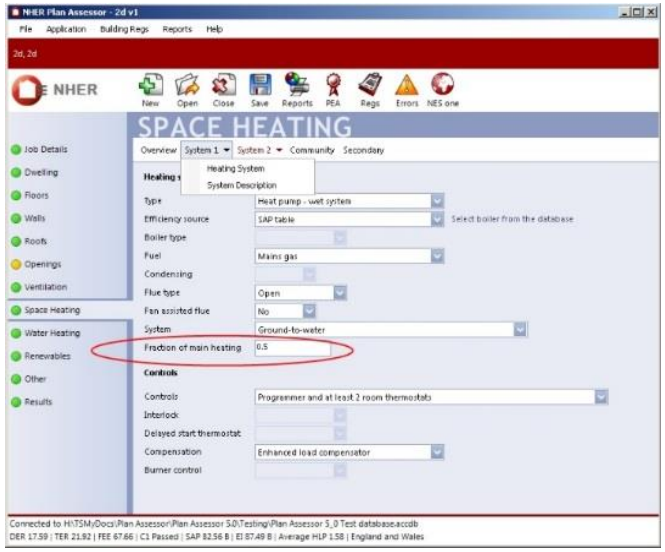
1) Carbon Emissions - DER<TER and DFEE<TFEE
2) Limits on Design Flexibility (minimum standards)
3) Limiting the effects of heat gains in summer
4) Building Performance consistent with DER (As Built)
5) Providing Information (As Built)

Part L – Tools

Residential

SAP - "Standard Assessment Procedure"

- Monthly heat gain / loss model
- Access style tools



Non-Residential

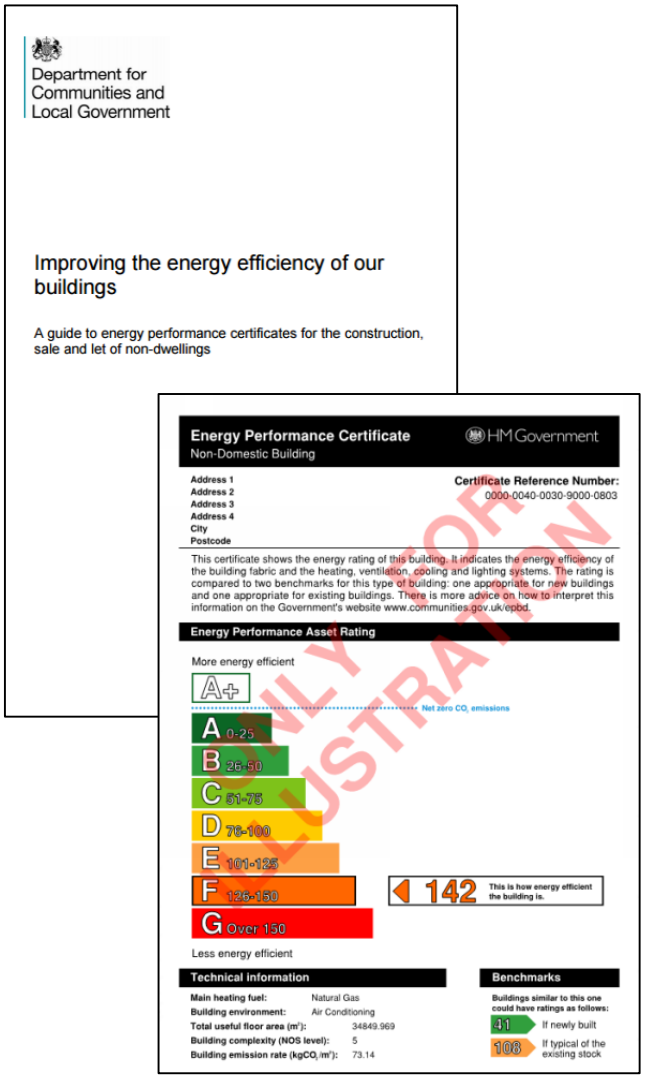
SBEM – "Simplified Building Energy Model"

- Freely available
- Monthly heat gain / loss model
- Access style tools

DTM – Dynamic Thermal Modelling

- Commercially available
- Hourly simulation of heat flows and building physics interactions

EPC – Energy Performance Certificates


Department for Communities and Local Government

Improving the energy efficiency of our buildings

A guide to energy performance certificates for the construction, sale and let of non-dwellings

Energy Performance Certificate
Non-Domestic Building

HM Government

Address 1
Address 2
Address 3
Address 4
City
Postcode

Certificate Reference Number:
0000-0040-0030-9000-0803

This certificate shows the energy rating of this building. It indicates the energy efficiency of the building fabric and the heating, ventilation, cooling and lighting systems. The rating is compared to two benchmarks for this type of building: one appropriate for new buildings and one appropriate for existing buildings. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Asset Rating

More energy efficient

A+ Net zero CO_2 emissions

A 0-25
B 26-50
C 51-75
D 76-100
E 101-125
F 126-150
G Over 150

142 This is how energy efficient the building is.

Less energy efficient

Technical information

Main heating fuel: Natural Gas
Building environment: Air Conditioning
Total useful floor area (m^2): 34849.969
Building complexity (NOS level): 5
Building emission rate ($kgCO_2/m^2$): 73.14

Benchmarks

Buildings similar to this one could have ratings as follows:
41 If newly built
108 If typical of the existing stock

ONLY FOR ILLUSTRATION

EPCs shows the energy efficiency rating (relating to running costs). The rating is shown on an A–G rating scale - similar to those on electrical appliances

EPC required on:

- Construction
- Sale
- Lease

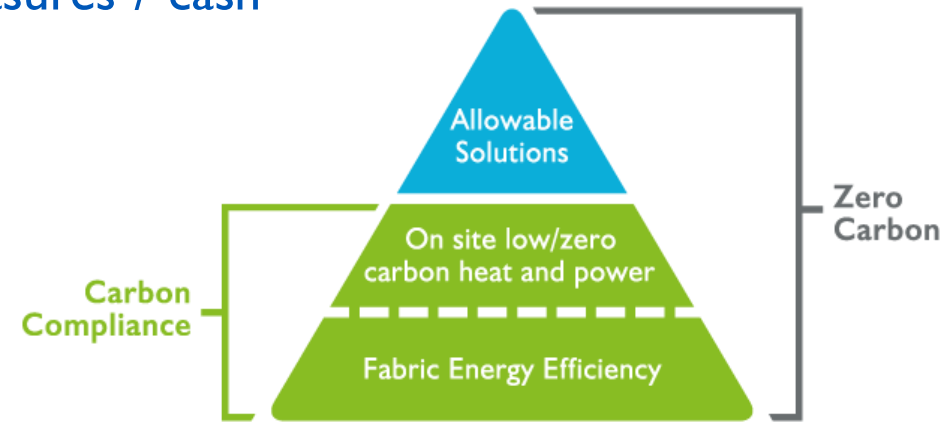
EPC NOT required for:

- Refurbishment / re-fit
- Any other modification

Minimum Energy Efficiency Standards - 2018

Local Planning Policy (London)

- Energy Hierarchy Approach
- Prioritises Heat Networks & CHP
- Overall CO2 reduction targets
- Residential = 'Zero Carbon' (100% reduction on Part L)
- Non-residential = 35% reduction on Part L
- Carbon emission targets - based on Part L
- Any shortfall to be made up by off-site measures / cash offset payment (£1,800 / tonne of CO_2)
- Overheating assessment
- Daylight / Sunlight requirements
- BREEAM requirements

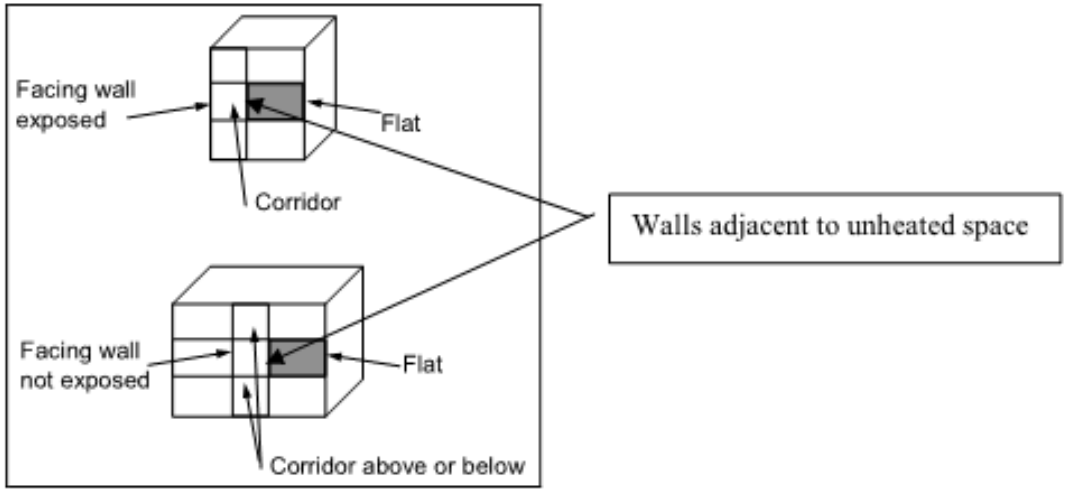


Using ‘Compliance’ tools to deliver ‘Performance’ outcomes

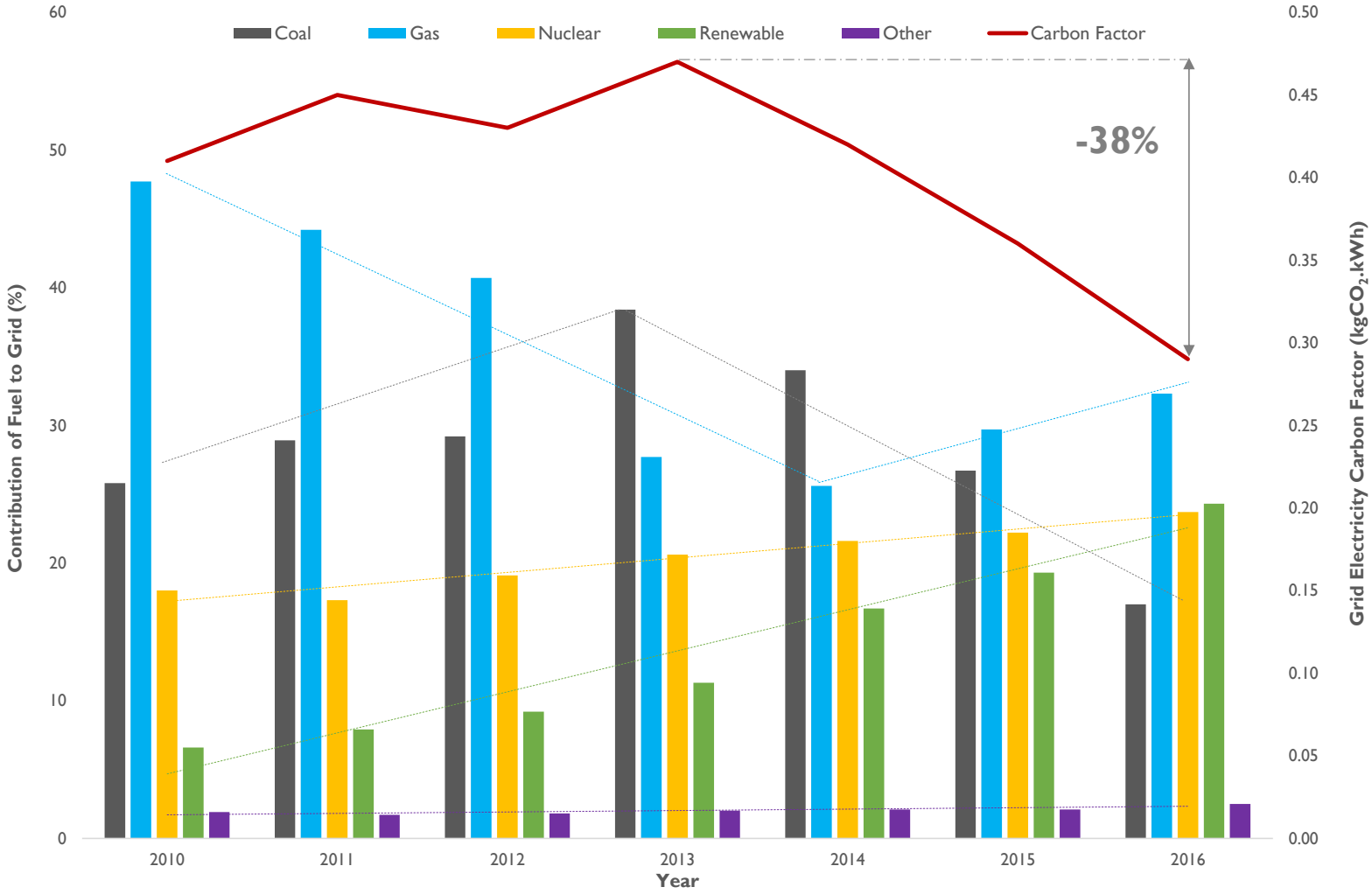
SAP

- Intended application
- Level of guidance
- Architectural intent can vary significantly…

SAP 2012 version 9.92 (October 2013)



Fuel Mix and Carbon Factor of Grid-Supplied Electricity

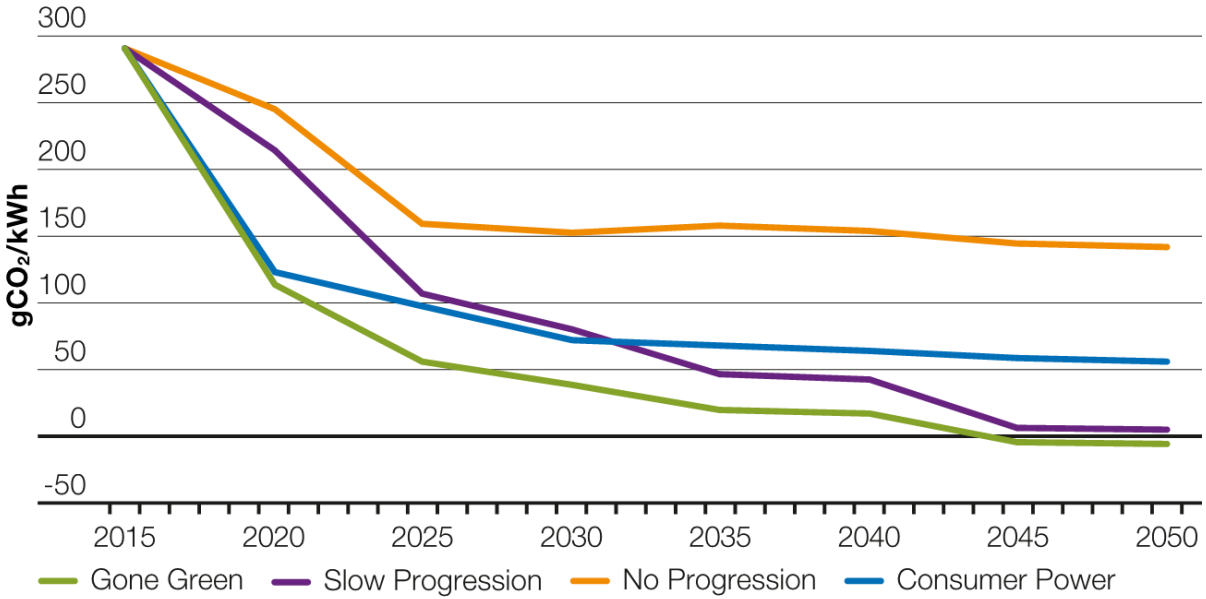


Historic fuel mix and carbon factor of the National Grid. *Source: http://electricityinfo.org/fuel-mix-of-uk-domestic-electricity-suppliers/*

Future Energy Scenarios (FES) 2016

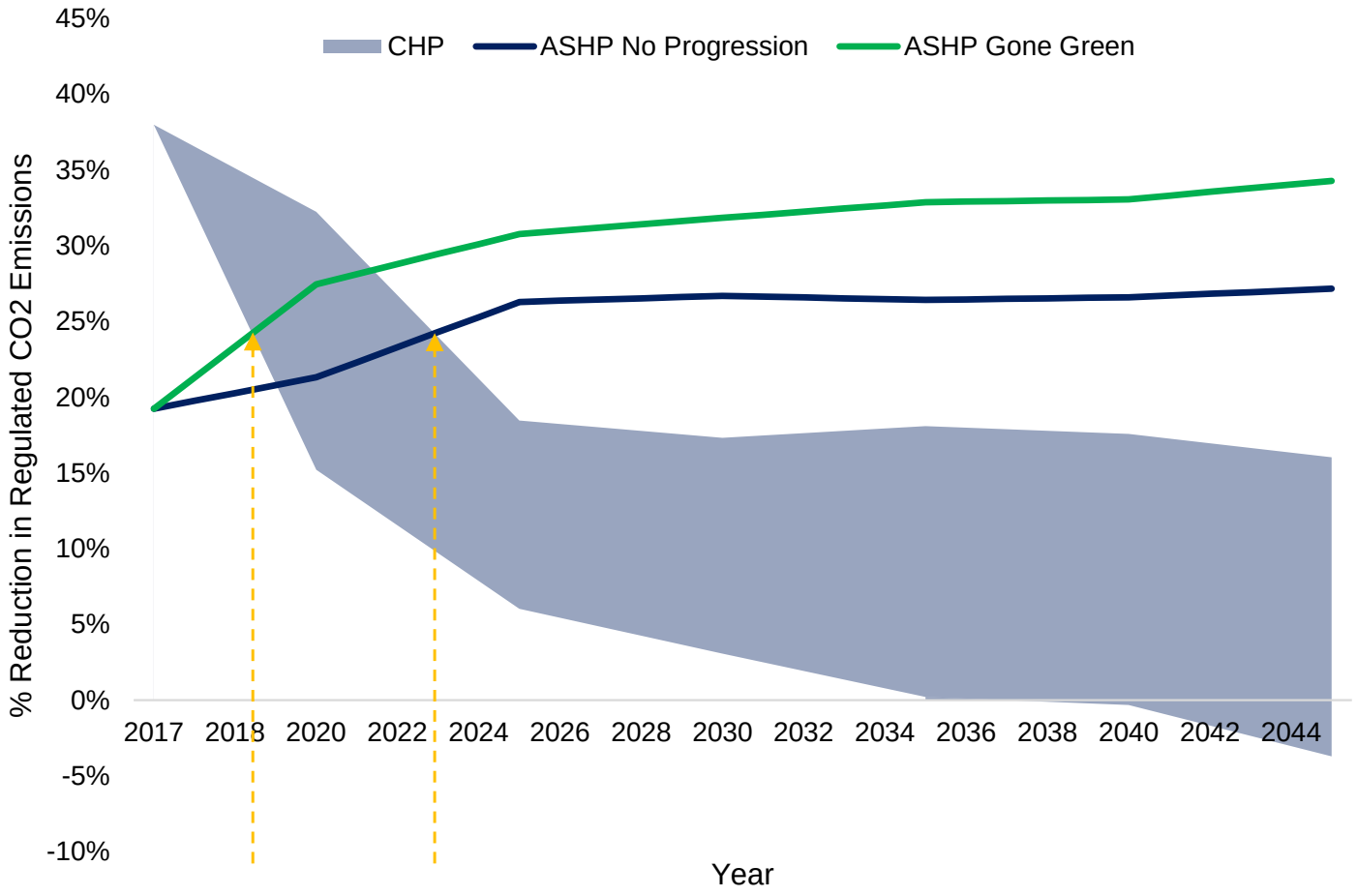
- Report produced by the National Grid.
- Investigates the changing energy landscape in the UK and presents future trends.
- Includes projections of the carbon intensity of generating electricity for distribution on the grid.

Figure 5.2.5
Carbon intensity of electricity generation



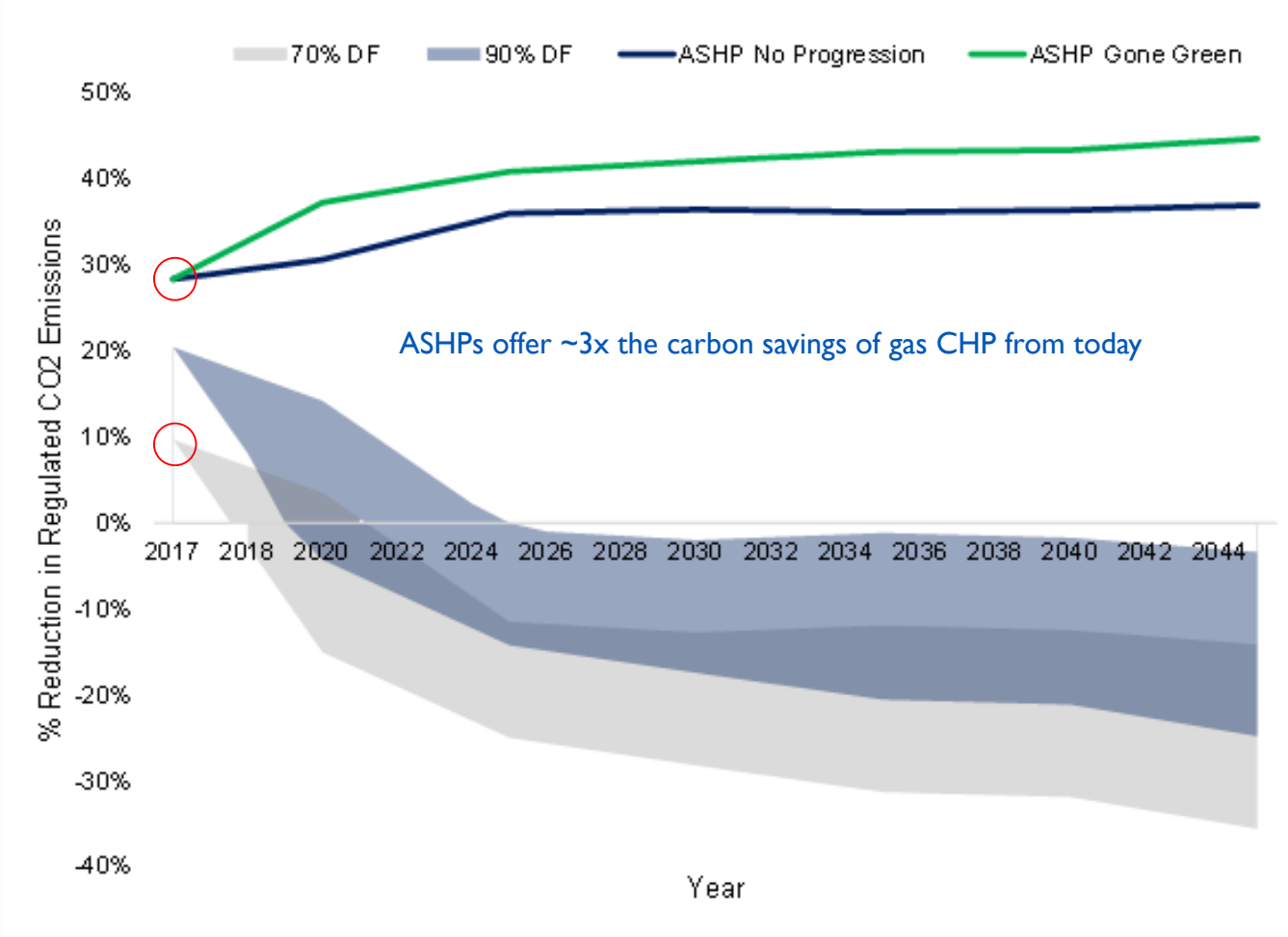
Carbon intensity of electricity generation taken from FES 2016. Does not include quoted 8% transmission and distribution losses.

CHP vs Heat-pump Technology



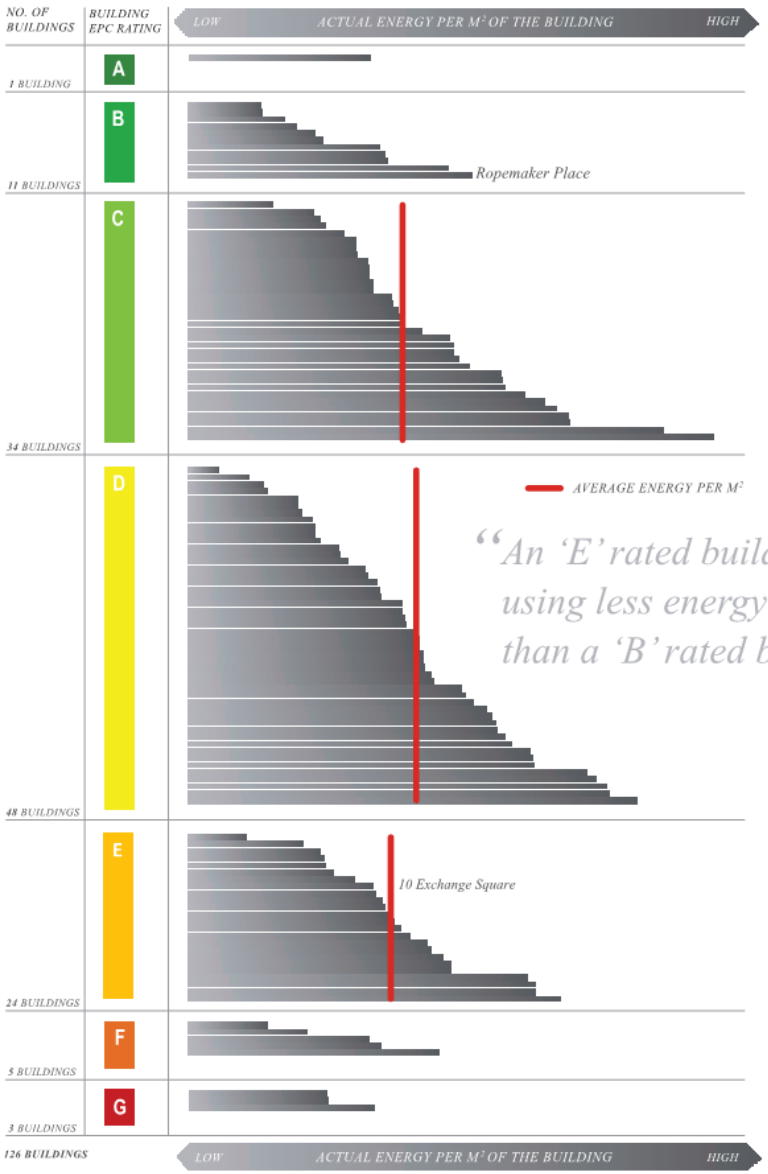
Using current Building Regs carbon factor (0.519 kgCO2/kWh) and District Heating Network distribution efficiency (90%)

CHP vs Heat-pump Technology



Using proposed BR carbon factor (0.400 kgCO2/kWh) and DHN distribution efficiency (70%).

EPC – Energy Performance Certificates – In practise?



"An 'E' rated building is using less energy per m² than a 'B' rated building."

JLL & Better Buildings Partnership – *A Tale of Two Buildings, Are EPCs a True Indicator of Energy Efficiency, 2012*

Minimum Energy Performance Standards

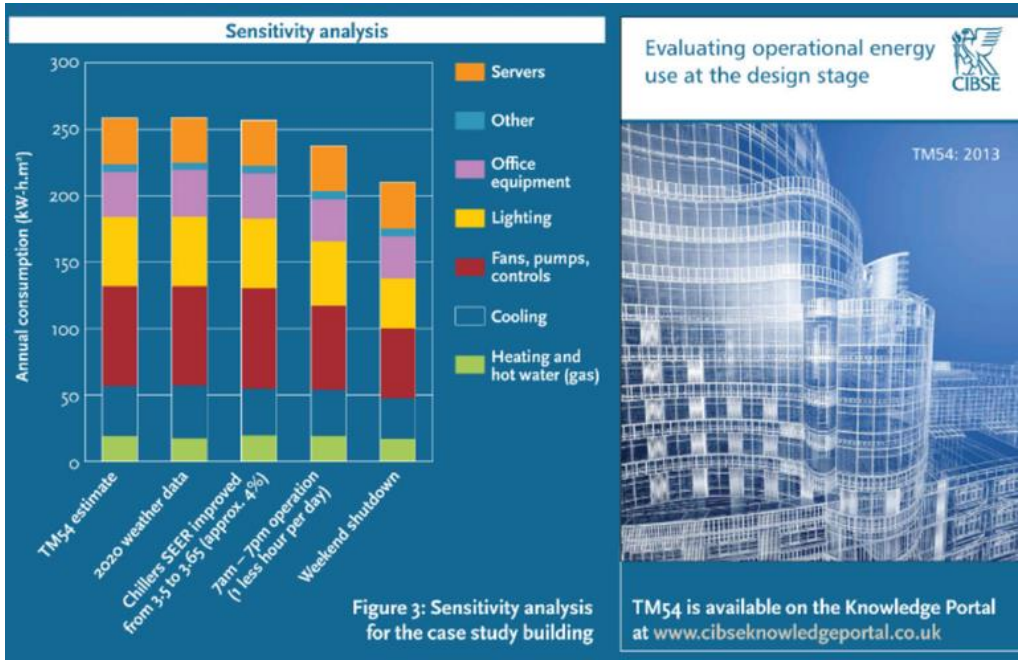
From April 2018, private landlords must ensure that properties they rent in England and Wales reach at least an Energy Performance Certificate (EPC) rating of E before granting a tenancy to new or existing tenants

‘Performance’ Approach

Potential Performance Approaches

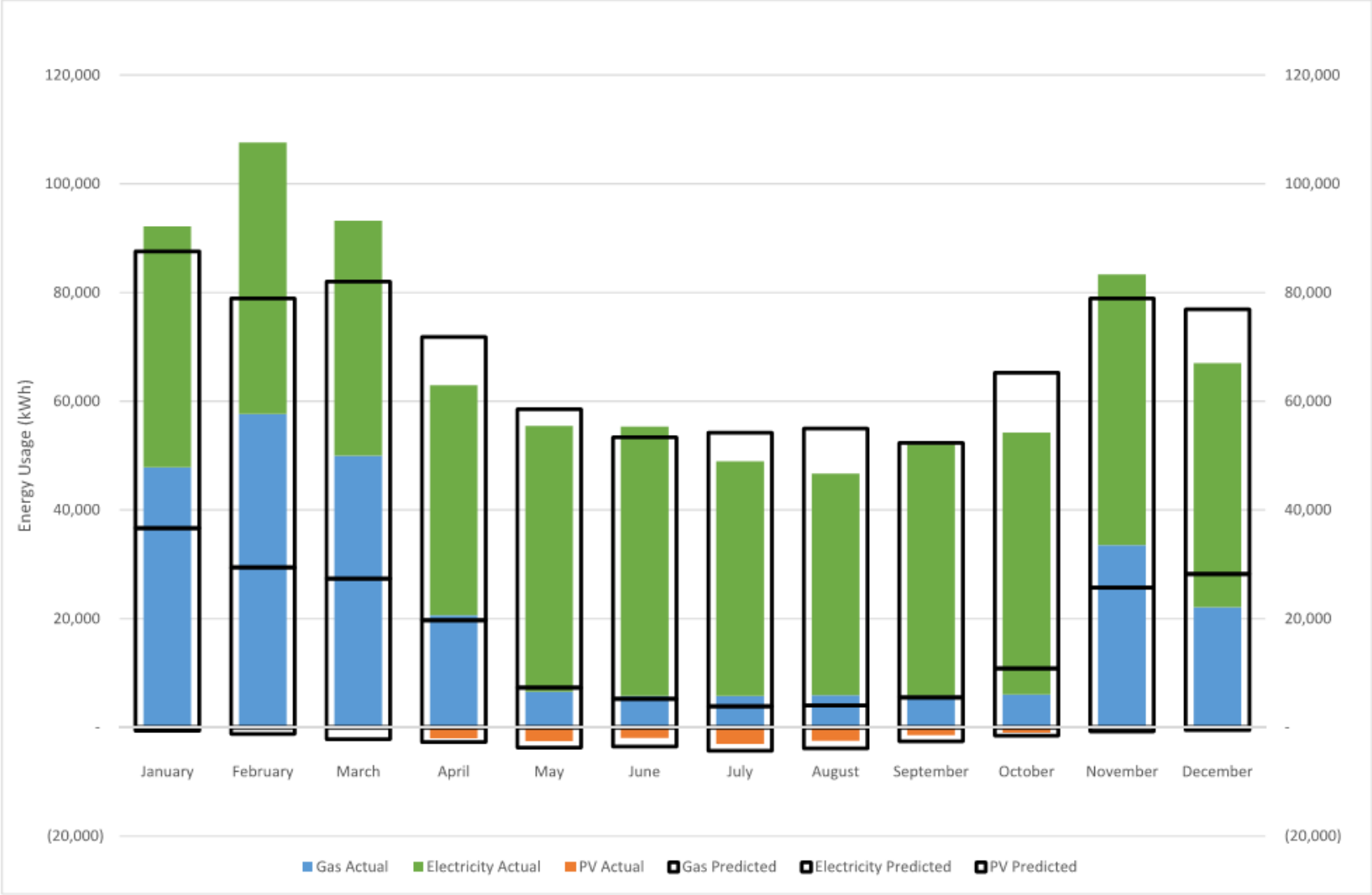
CIBSE TM54 - Evaluating Operational Energy Performance of Buildings at the Design Stage

- Methodology for more representative assessments of in-use energy usage
- Integrates with DTM modelling
- Allows designers and engineers to model human behaviour in more detail than NCM
- Can test different operating scenarios
- Includes unregulated loads



Potential Performance Approaches

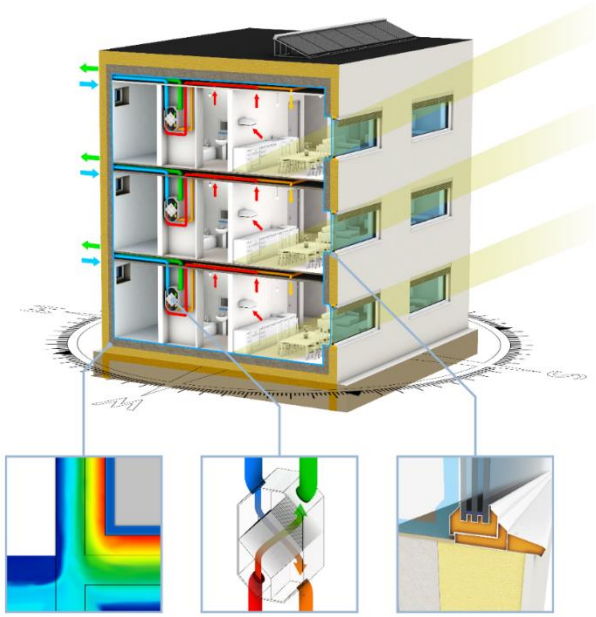
CIBSE TM54 - Evaluating Operational Energy Performance of Buildings at the Design Stage

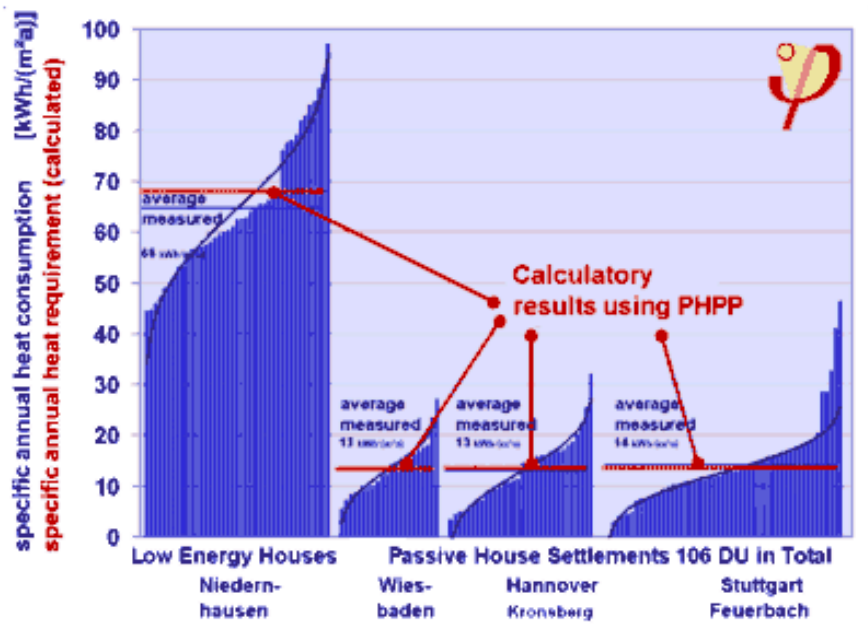


Potential Performance Approaches

Passivhaus

- Certified design standard for occupant comfort and low energy buildings
- Steers design down a prescriptive path (insulate, build tight, ventilate right, eliminate space heating demand)
- Significant focus on design details and construction checks





Potential Performance Approaches

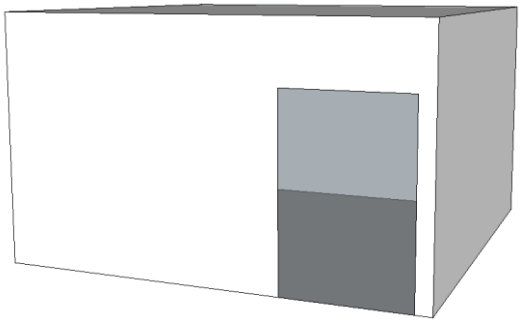
NABERS

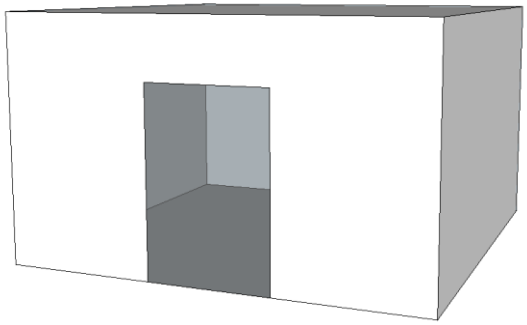
- Based on measured energy performance, not a design estimate.
- NABERS rating is estimated during design and construction, but is only validated after the building has been occupied and the energy has been measured, typically 12-18 months after occupation.
- Potential for market transformation

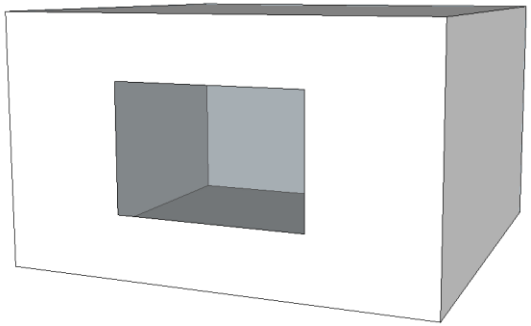
Potential Performance Approaches

Consideration of Daylight throughout design

- From planning stages to final façade specification and installation





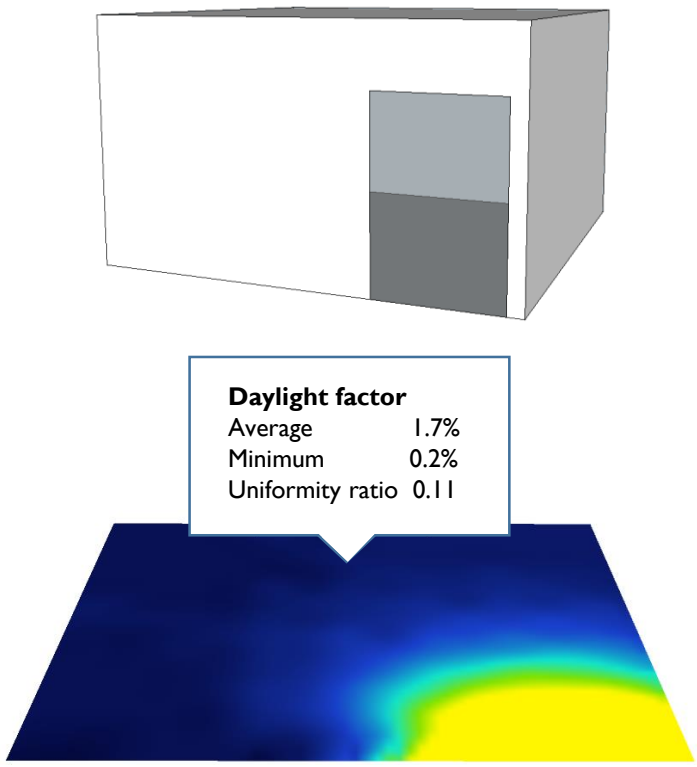


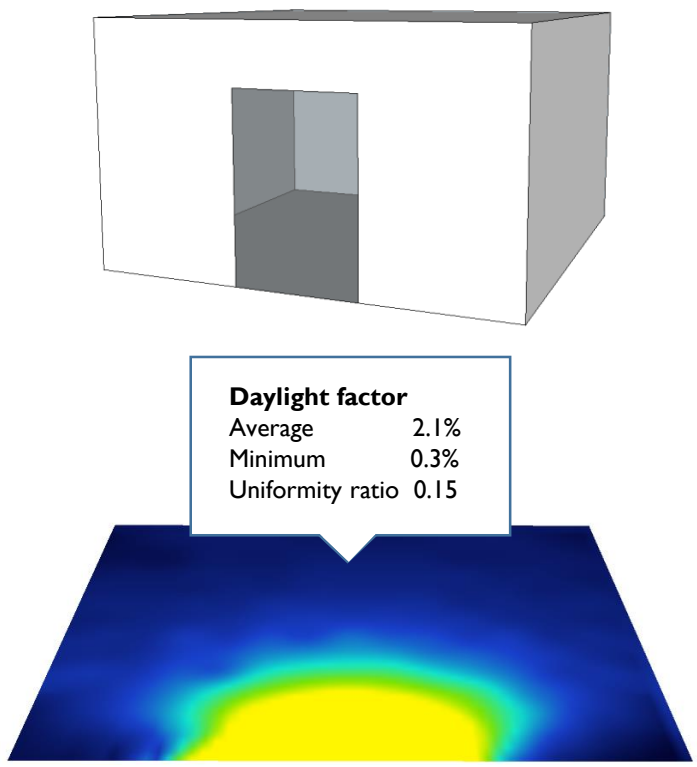
Which of these designs provides the best daylight for occupants?

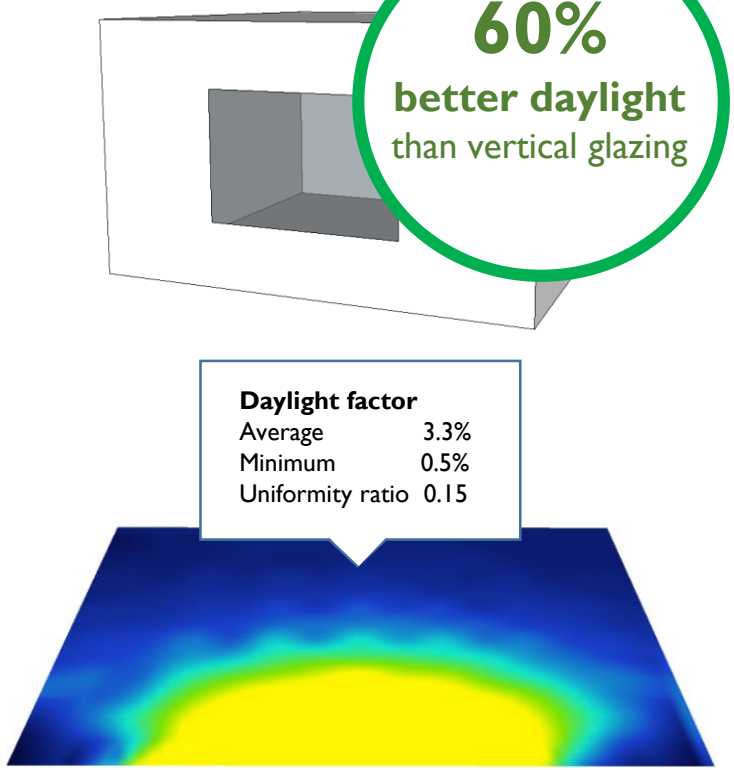
Potential Performance Approaches

Consideration of Daylight throughout design

- From planning stages to final façade specification and installation







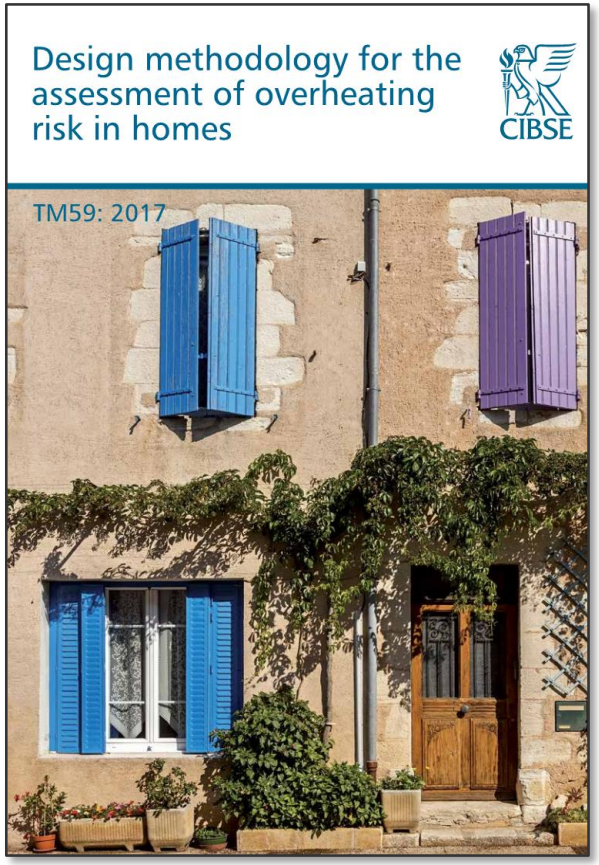
60%
better daylight
than vertical glazing

Potential Performance Approaches

CIBSE TM 59 : Design methodology for the assessment of overheating risk in homes

Key Updates:

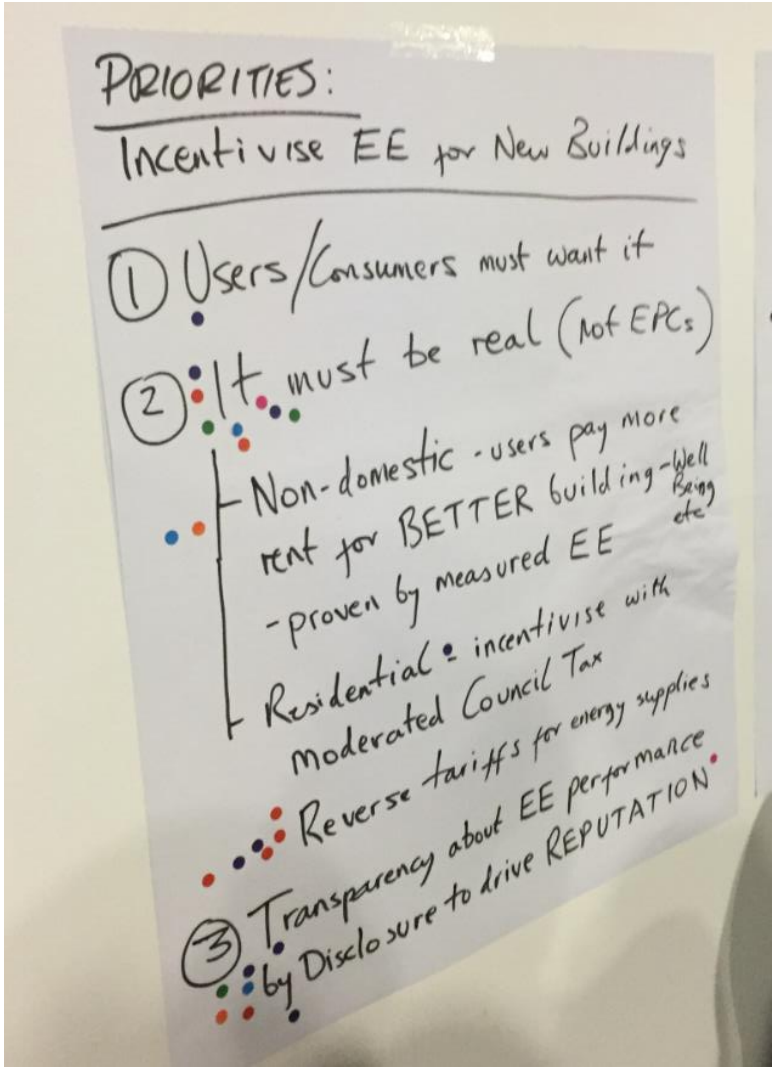
- Standardised occupancy profiles (24/7)
- Standardised equipment heat gains (per room type)
- Clarification of overheating criteria (when adaptive or fixed method applies)
- Risk assessment responsibilities

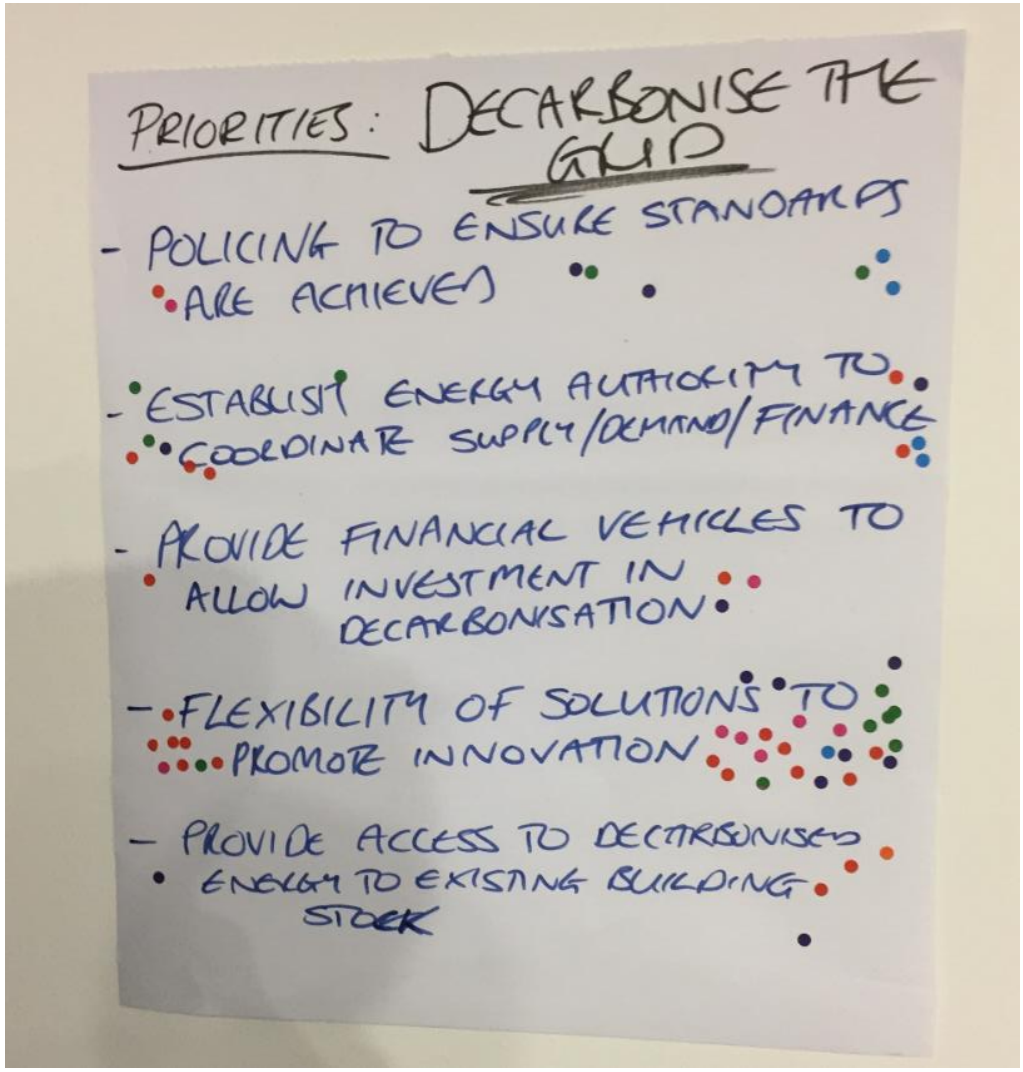


Conclusions:

- Engineers / designers often need to wear two hats (compliance and reality)
- Honest recognition of the value and limitations of tools is crucial
- Clear and open communication of this to clients / planners is both highly important, and can also be very challenging
- Career diversity and good communication skills is of huge benefit to building simulation professionals
- Challenging market conditions and competitive pricing can contribute to "compliance" only approaches
- The challenge for engineers is to be able to explain the full value of performance based approaches to clients, those authoring regulations and policy makers

Final Thoughts:





Industry Workshop Outputs: "Fixing London's Broken Energy Policy" – The Building Centre, May 2017