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?

Energy Efficiency
CO2 Emissions
Energy Bills
Thermal Comfort
Daylight / Sunlight
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 (CO₂ / 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

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 CO2)
- 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…
### Fuel Mix and Carbon Factor of Grid-Supplied Electricity


<table>
<thead>
<tr>
<th>Year</th>
<th>Coal</th>
<th>Gas</th>
<th>Nuclear</th>
<th>Renewable</th>
<th>Other</th>
<th>Carbon Factor</th>
</tr>
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<tbody>
<tr>
<td>2010</td>
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**Graph Description:**
- The graph illustrates the contribution of different fuels to the grid's electricity supply over the years 2010 to 2016.
- The carbon factor (in kgCO₂/kWh) is shown on the right axis.
- The contribution of each fuel type is represented by different colors: Coal (black), Gas (teal), Nuclear (yellow), Renewable (green), Other (purple).
- The overall trend shows a decrease in carbon factor, with a notable decrease of -38% from 2010 to 2016.

**Note:** The source link provides detailed information on the fuel mix and carbon factor data for the National Grid.
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.

Carbon intensity of electricity generation taken from FES 2016. Does not include quoted 8% transmission and distribution losses.
Using current Building Regs carbon factor (0.519 kgCO2/kWh) and District Heating Network distribution efficiency (90%)
Using proposed BR carbon factor (0.400 kgCO2/kWh) and DHN distribution efficiency (70%).

ASHPs offer ~3x the carbon savings of gas CHP from today.
EPC – Energy Performance Certificates – In practise?

<table>
<thead>
<tr>
<th>NO. OF BUILDINGS</th>
<th>ACTUAL ENERGY PER M² OF THE BUILDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 BUILDING</td>
<td>Low</td>
</tr>
<tr>
<td>2 BUILDINGS</td>
<td>Low, Average</td>
</tr>
<tr>
<td>3 BUILDINGS</td>
<td>Low, Min, Max</td>
</tr>
<tr>
<td>4 BUILDINGS</td>
<td>Low, Average, Min, Max</td>
</tr>
<tr>
<td>5 BUILDINGS</td>
<td>Low, Average, Min, Max, High</td>
</tr>
</tbody>
</table>


“An ‘E’ rated building is using less energy per m² than a ‘B’ rated building.”

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:

PRIORITIES:  
Incentivise EE for New Buildings

1. Users/Consumers must want it
2. It must be real (not EPCs)
   - Non-domestic - users pay more rent for BETTER building
   - Proven by measured EE
   - Residential - incentivise with moderated Council Tax
   - Reverse tariffs for energy supplies
3. Transparency about EE performance
   - By Disclose to drive REPUTATION

PRIORITIES: DECARBONISE THE GRID

- POLICING TO ENSURE STANDARDS ARE ACHIEVED
- ESTABLISH ENERGY AUTHORITY TO COORDINATE SUPPLY/Demand/FINANCE
- PROVIDE FINANCIAL VEHICLES TO ALLOW INVESTMENT IN DECARBONISATION
- FLEXIBILITY OF SOLUTIONS TO PROMOTE INNOVATION
- PROVIDE ACCESS TO DECARBONISED ENERGY TO EXISTING BUILDING STOCK