CIBSE Application Manual AM11 'Building Performance Modelling'

Chapter 3: Modelling for energy performance regulations compliance & certification

Contents

- Background
- Compliance modelling vs design modelling
- Modelling for building energy performance regulations compliance & certification
- Modelling for building assessment & rating schemes
- Validity of results

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Background [Section 3.1]

Objectives & Scope (3.1.1-3.1.2)

- familiarise general users with energy performance related regulatory processes in various countries where modelling is used
- ensure the differences between compliance modelling & modelling for design are well understood & where overlaps exist
- make users of compliance modelling tools aware of QA principles

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Background [Section 3.1]

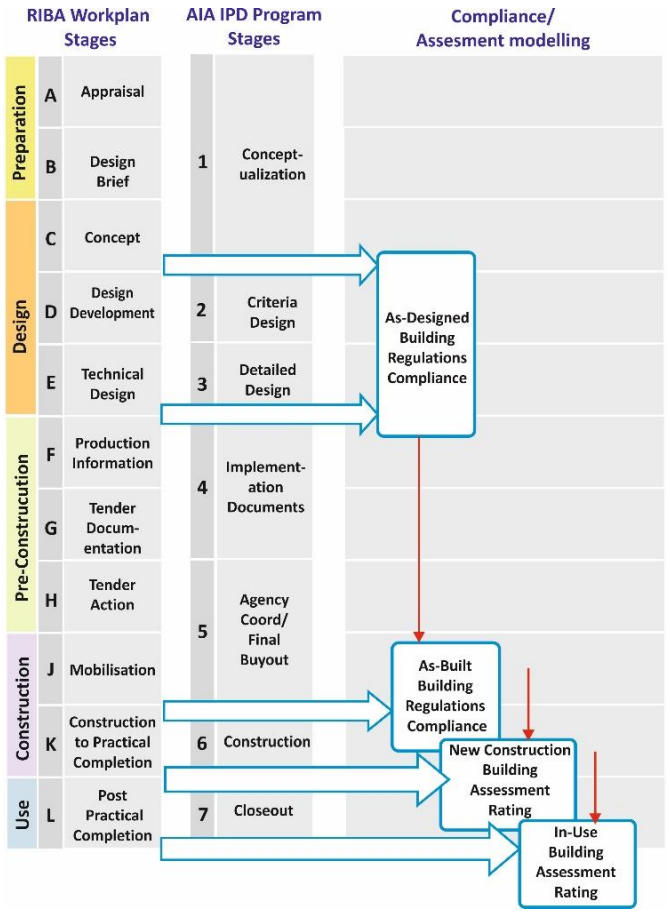
Modelling for compliance (3.1.3)

- What is Compliance?
- What Can you Comply with?

  Energy Efficiency Legislation

  Assessment Systems
- When does compliance modelling occur?

  RIBA & AIA IPD mapping



Key stages for compliance modelling in the project life cycle (Fig. 3.1)

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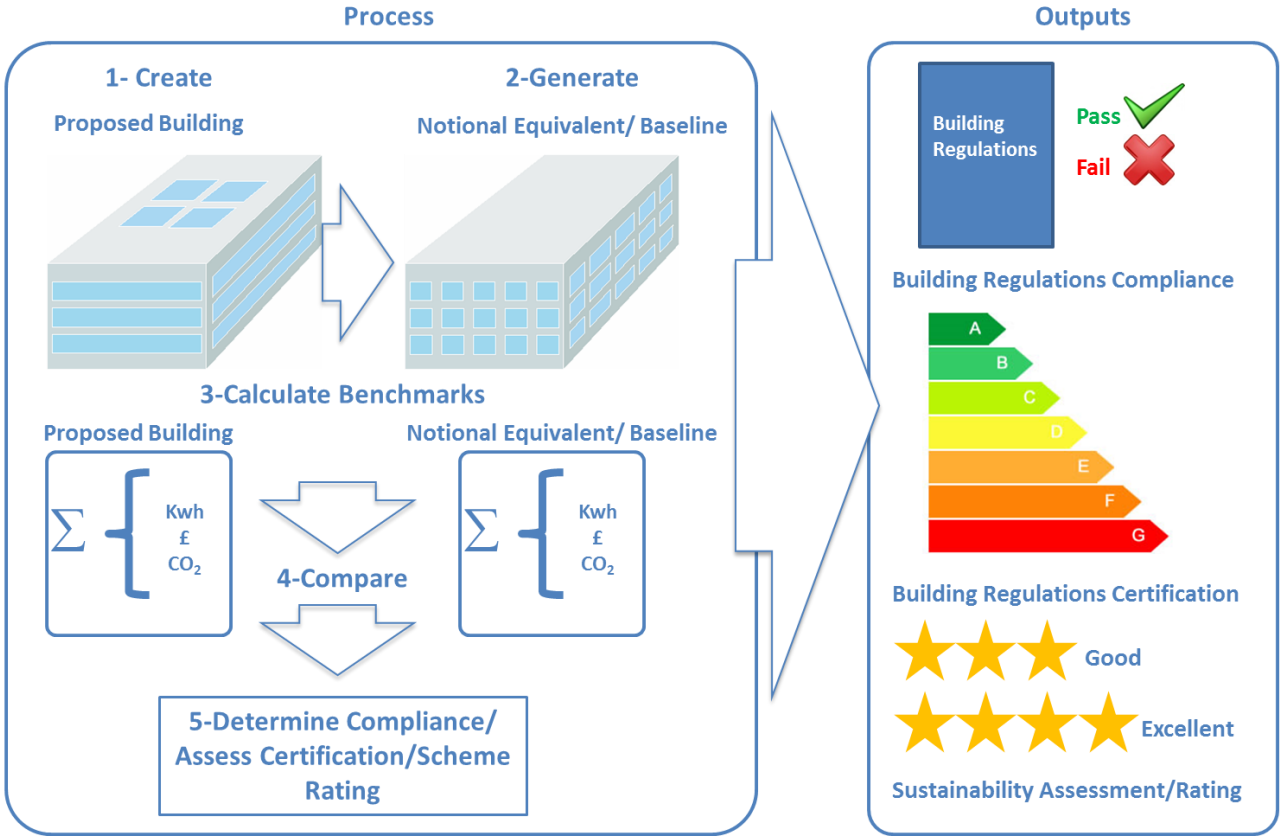
General Modelling Approach [Section 3.2]



(Fig 3.2) General Compliance/Rating Assessment Process

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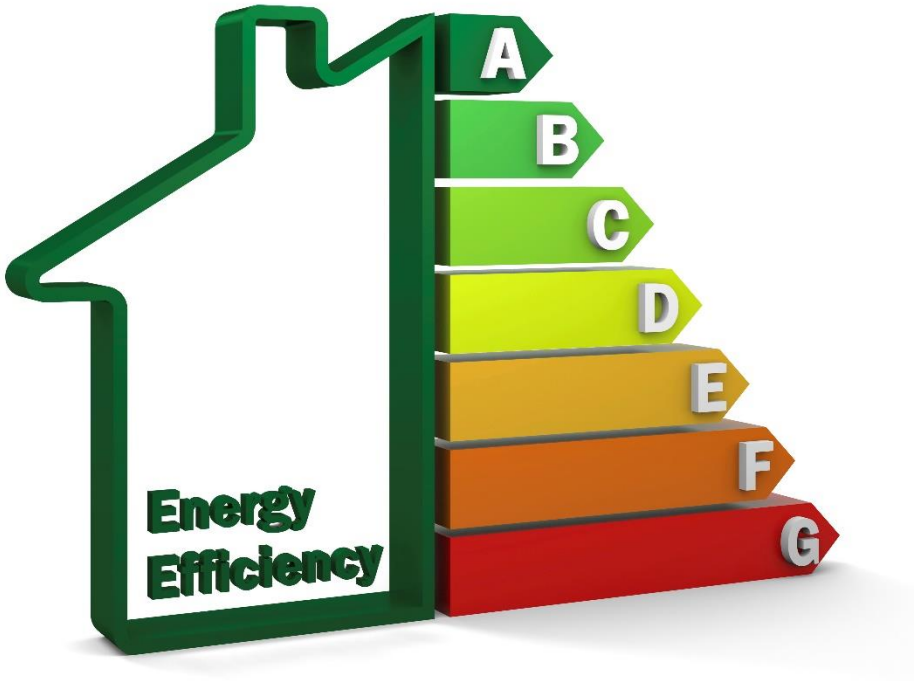
General Modelling Approach [Section 3.2]

General Definitions:

- Compliance Methodology
- Modelling/Simulation Tool
- Proposed Design
- Notional, Baseline or Reference Buildi
- Compliance Benchmark



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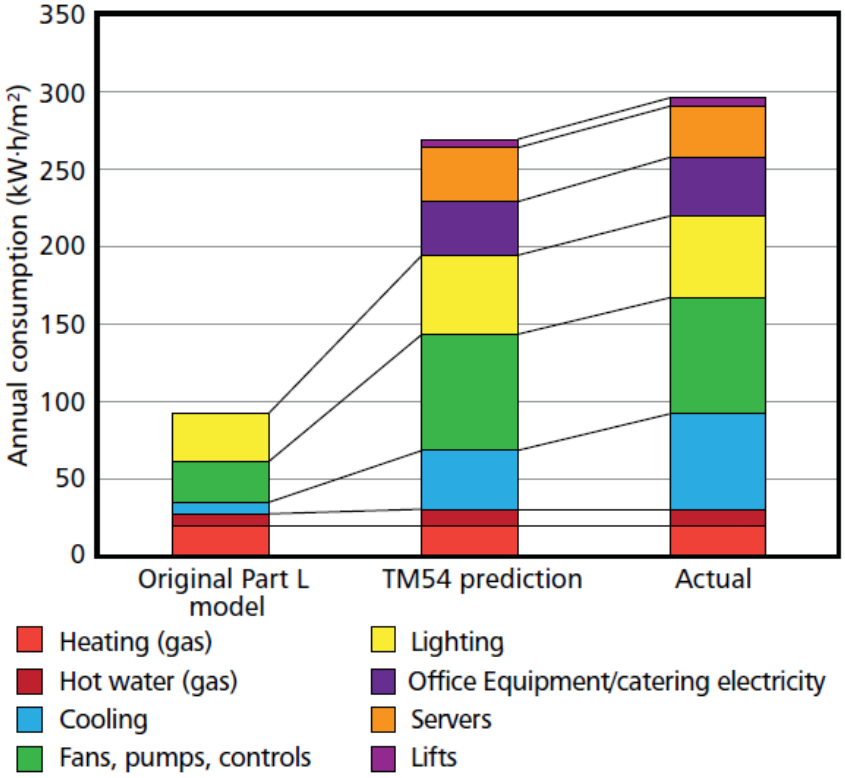
Compliance vs Design Modelling [Section 3.3]

Key differences:

- Some energy or mass flow paths may be approximated or omitted, may only focus on 'regulated' energy uses
- Limited ability in representing complexities of HVAC systems & dynamic interconnectedness of building technologies
- Limited ability to account for impact of possible future changes in climate & occupant behaviour



(Fig. 3.4) Compliance Vs. Design Modelling Vs. Actual Energy Use (Menezes, 2012)

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Modelling for energy performance regulations compliance & certification [Section 3.4]

European Legislation & Policy

- 2000-European Climate Change Programme (ECCP)
- 2002-European Energy Performance of Buildings Directive (EPBD)
- 2010- Recast of European Energy Performan (EPBD2)

- Extends scope of 2002 EPBD
- Strengthens certain provisions
- Gives public sector leading role in energy efficiency

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Modelling for energy performance regulations compliance & certification [Section 3.4]

In the UK:

In accordance with the requirements stated in Article 3 of the EPBD, the National Calculation Methodology (NCM) was defined by the ODPM as ***the unified calculation-based methodology*** for the demonstration of compliance.

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Modelling for energy performance regulations compliance & certification [Section 3.4]

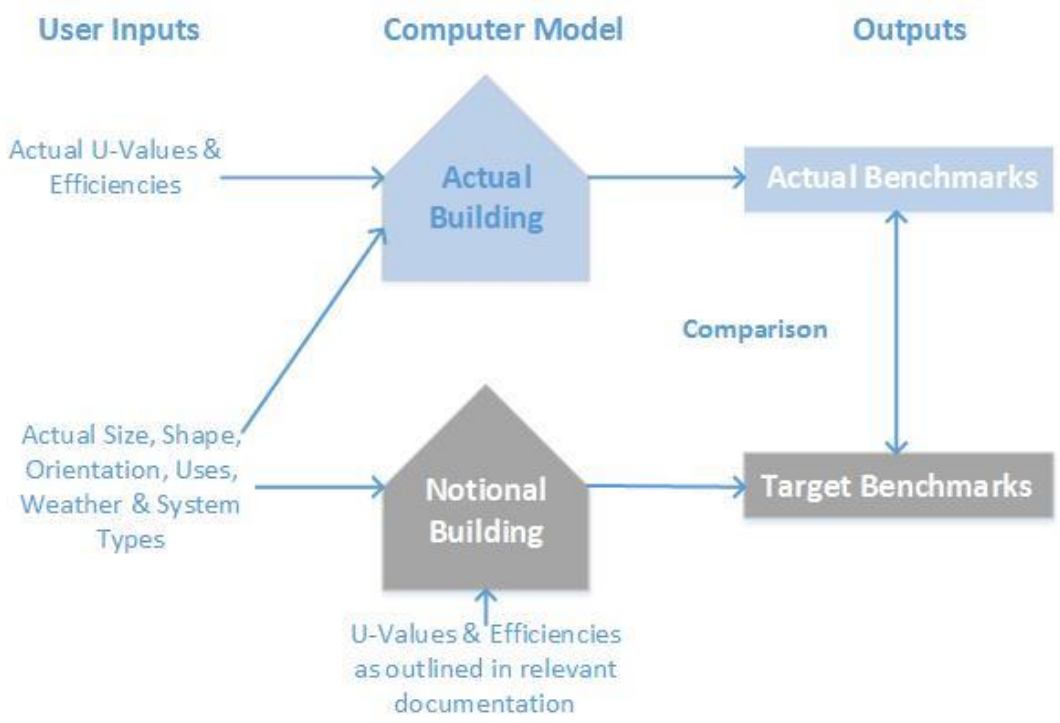
The UK Case (section 3.4.1.1):

- Devolved administrative structure
- Jurisdictions: England, Wales, Scotland & Northern Ireland
- Each governed by separate body issuing their own regulatory documents.

Modelling for energy performance regulations compliance & certification [Section 3.4]

The UK Case (section 3.4.1.1):

- Unified NCM method
- Relevant technical guides
- Compliance requirements
- Secondary associated documents



(Fig 3.6) Compliance procedure for the NCM

Adapted from BSRIA, 2010

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Modelling for energy performance regulations compliance & certification [Section 3.4]

The UK Case (section 3.4.1

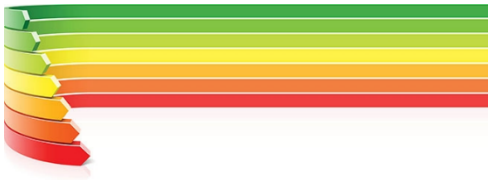
Building typology	Guidance	Method	Compliance demonstration (whole building/dwelling calculation method)		EPC certification		Further information
			Notional building	Target benchmarks	Reference building	SER (or equivalent)	
New dwellings	ADL1A	Standard Assessment Procedure (SAP2012)	Concurrent notional dwelling of the same size and shape, constructed according to the reference values set out in Appendix R of SAP 2012 (summarised in the appendix of ADL1A)	TER is calculated in two stages: (1) Calculate CO_2 emissions from heating (CH), pumps and fans (CPF) and lighting (CL) for the notional dwelling (2) Calculate the TER2013 using equation in the relevant approved document. TFEE = 1.15 × fabric energy efficiency of notional dwelling (kW·h/m²·year)	Generated by the simulation tool and is the same size and shape as the actual building	Determined by applying a fixed improvement factor to the emissions from a reference building	Regulations: gov.wales/topics/planning/buildingregs/publications/part-l-energy/?lang=en Tools and methods: www.bre.co.uk/sap2012
Existing dwellings 'Equivalent Carbon Target Approach'	ADL1B	Standard Assessment Procedure (SAP2012)	Benchmark should comply with the relevant *U*-value standards and limit on the area of window and doors where work to the existing dwelling/ building is proposed as set out in the relevant sections of ADL1B	CER= the carbon emissions rate of the proposed building should be no greater than the 'fully compliant benchmark'.	Generated by the simulation tool and is the same size and shape as the actual building	Determined by applying a fixed improvement factor to the emissions from a reference building	Regulations: gov.wales/topics/planning/buildingregs/publications/part-l-energy/?lang=en Tools and methods: www.bre.co.uk/sap2012
New buildings other than dwellings	ADL2A	Simplified building energy model (SBEM) or accredited commercial tools	Concurrent notional building of the same size and shape as the actual building, constructed according to the properties set out in the Appendix of the 2014 Approved Document and	TEPC = primary energy consumption of the notional building TER = CO_2 emissions from the notional building	Generated by the simulation tool and is the same size and shape as the actual building	Determined by applying a fixed improvement factor to the emissions from a reference building	Regulations: gov.wales/topics/planning/buildingregs/publications/part-l-energy/?lang=en Tools and methods:

(Table 3.3) Application of the NCM procedure: Wales 2014 Regulations

Modelling for energy performance regulations compliance & certification [Section 3.4]

The UK Case (section 3.4.1.1):

- Building Certification Requirements
  - The Asset Rating (AR)- Energy Performance Certificates
  - The Operational Rating (OR)- Display Energy Certificates

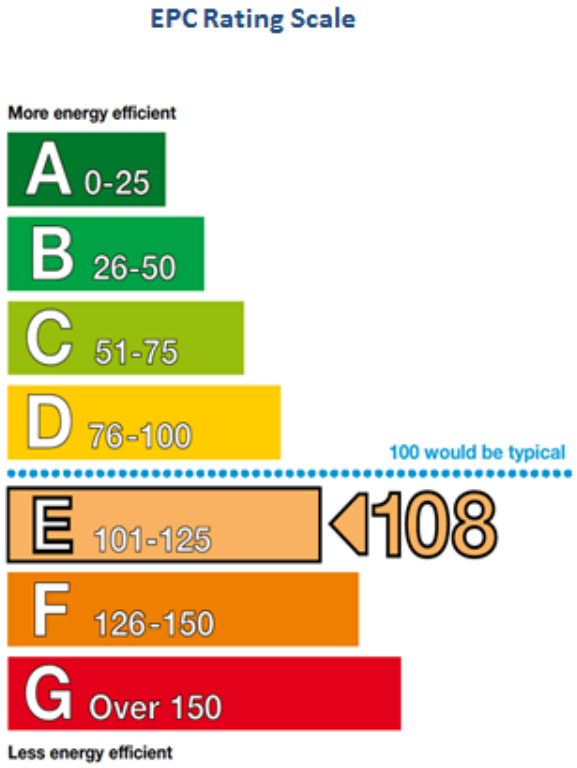


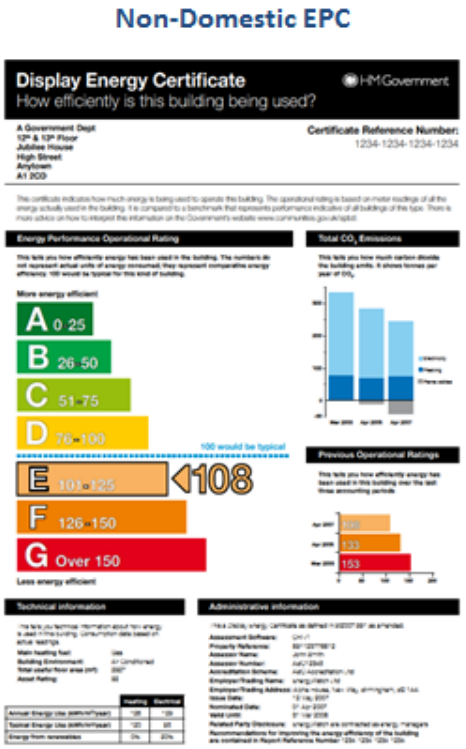
AR *= 50 * BER / SER*

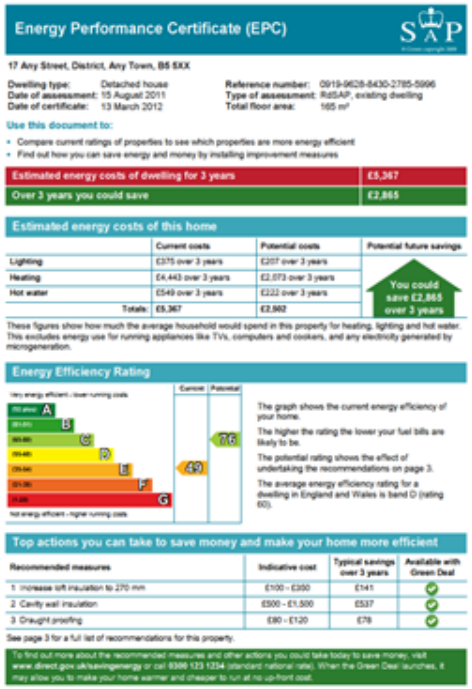
OR *= (Building CO_2 emissions/Building area) x (100/Typical CO_2 emissions per unit area)*

Modelling for energy performance regulations compliance & certification [Section 3.4]

The UK Case (section 3.4.1)







(Fig 3.7) Rating Scale for Energy Performance Certification & Example EPCs Source: DCLG 2008, 2012

Modelling for energy performance regulations compliance & certification [Section 3.4]

The UK Case (section 3.4.1.1):

Modelling Tools

- Accredited tools
- Accreditation processes & schemes

CLASS	INPUT METHOD/DATA	CALCULATION METHOD	OUTPUTS
SBEM	Non-graphical, Microsoft Access based forms.	Monthly Average	-BRUKL/SBEM outputs -Data reflection reports -EPC Certificates
FI-SBEM TYPE A	Front-end graphical interface is used for geometry input. Interfaces with iSBEM for additional input.	Monthly Average	-BRUKL/SBEM outputs -Data reflection reports -EPC Certificates
FI-SBEM TYPE B	A front-end graphical interface is used for building geometry & information input.		
DSM	3D CAD front-end modules allow building geometry to be input &/or imported from CAD packages, 3D BIM & other software.	Detailed Hourly	-BRUKL/SBEM outputs -Data reflection reports -EPC Certificates -Load /energy analysis

Modelling for energy performance regulations compliance & certification [Section 3.4]

Other EU nations (sections 3.4.1.2-3.4.1.4):

Netherlands, France, Germany

Beyond the EU (sections 3.4.2.1-3.4.2.4)

USA, Australia, Canada, Hong Kong

- Compliance requirements & modelling approach
- Building certification requirements
- Modelling tools

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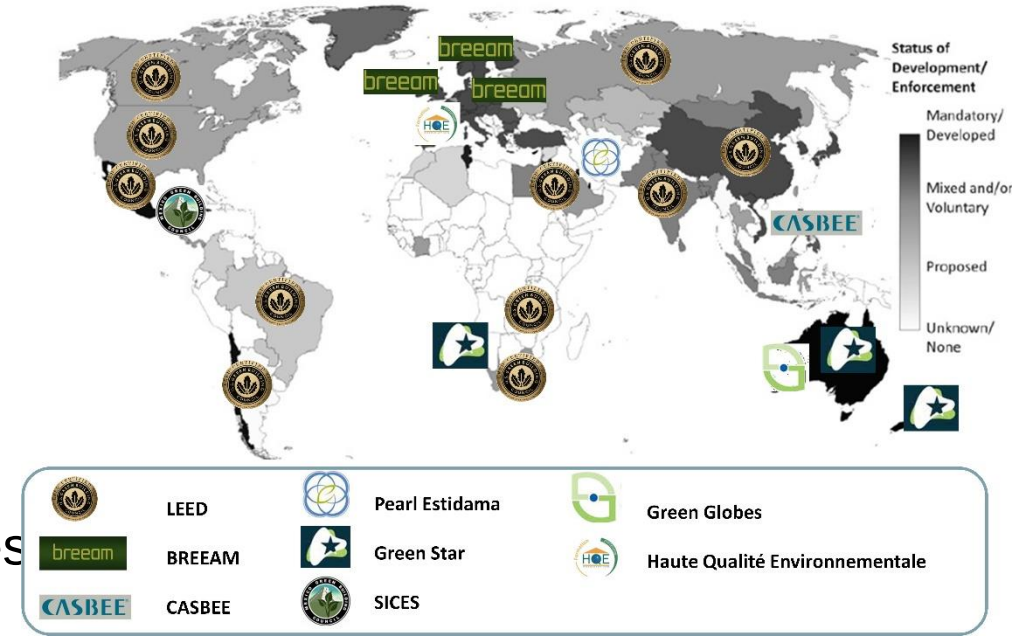
Modelling for building assessment & rating schemes [Section 3.5]

- Industry adopted standards, which set higher performance targets compared to national regulations
- Compliance checking with national building regulations an integral component for allocation of credits
- Overview of rating schemes in over 30 countries
- Focus on key International schemes



(Fig 3.8) Building assessment & certification schemes

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Modelling for building assessment & rating schemes [Section 3.5]

- Key International schemes (sections 3.5.1-3.5.4)

LEED, BREEAM, GreenStar, Pearl Estidama

- **Scheme overview**
- **Relevant energy credits**
- **Compliance requirements**
- Modelling approach
- Modelling tools

LEED Rating System	EAP2 Method & requirement	EAc1 Method & requirement
Existing Buildings: Operations & Maintenance	Compare performance with the national average for similar building type where : Energy Star EPA Rating ≥ 69 or USGBC Option B & C calculator shows energy efficiency ≥19% better than national average.	Compare performance with the national average for similar building type where : Energy Star EPA Rating ≥ 71 or USGBC Option B & C calculator shows energy efficiency ≥21% better than national average.
New Buildings: New Construction, Schools, Comm Interiors, Core & Shell	Demonstrate a specified % energy cost savings compared to ASHRAE 90.1 baseline through the use of the PRM	Demonstrate further energy cost savings compared to ASHRAE 90.1 baseline through the use of the PRM
Retail	Comply with ASHRAE 90.1 through the use of the PRM	Demonstrate further energy cost savings compared to ASHRAE 90.1 baseline through the use of the PRM
Healthcare	Demonstrate 10% energy cost savings compared to ASHRAE 90.1 baseline through the use of the PRM	Demonstrate further energy cost savings compared to ASHRAE 90.1 baseline through the use of the PRM

(Table 3.15) LEED Compliance methods & energy credit requirem

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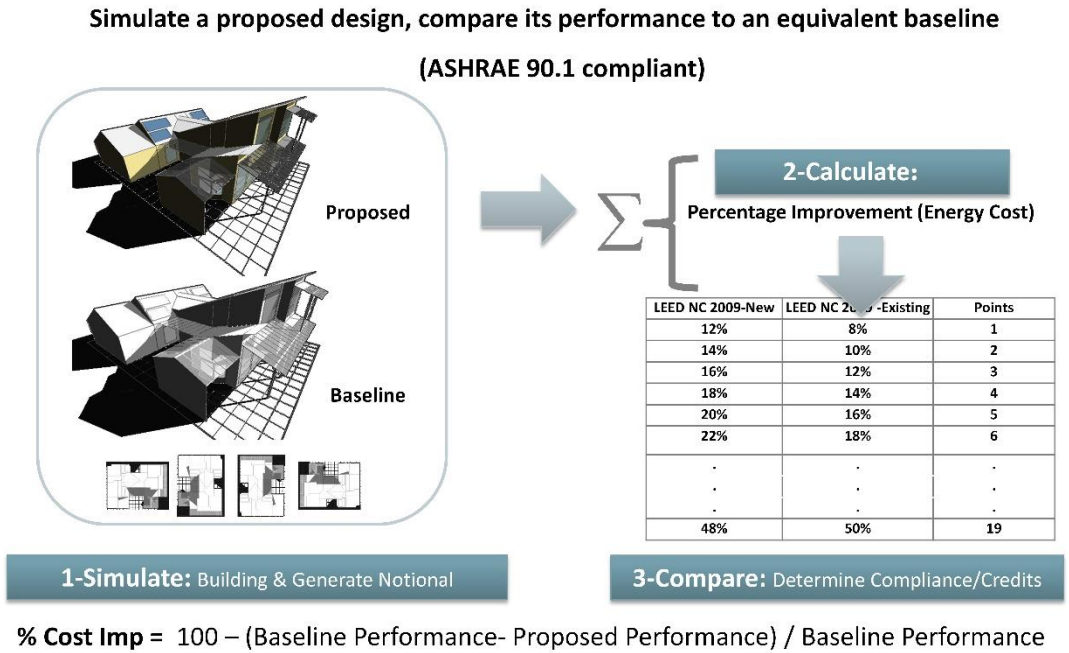
Modelling for building assessment & rating schemes [Section 3.5]

- Key International schemes (sections 3.5.1-3.5.4)

LEED, BREEAM, GreenStar, Pearl Estidama

- Scheme overview
- Relevant energy credits
- Compliance requirements
- **Modelling approach**
- **Modelling tools**



(Fig 3.9) The PRM method as applied for LEED NC

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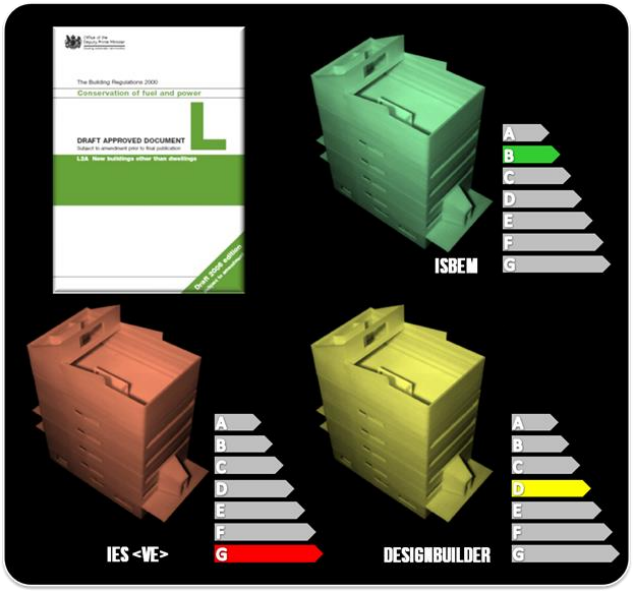
Validity of Compliance Modelling Results [Section 3.6]

Potentially calls into question the validity of modelling results & the impact on the credibility of using modelling as a tool for demonstrating legislative compliance & allocating building ratings

Causes of predictive variability

- Reliability & accuracy of physical input data
- User skill in data interpretation & tool use
- Applicability of the tool to the building & climate
- Ability of the tool to predict building performance/ calculation method used.



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Summary & conclusions

- Compliance modelling may occur throughout the building's lifecycle & has been increasingly integrated into planning application processes at local/city level.
- Compliance & design modelling are not the same, despite overlaps.
- Compliance modelling is simplified, indicative = not suitable for design development.
- Modelling methodologies utilises a common approach: Proposed designs are compared against benchmarks using accredited simulation tools
- Environmental sustainability ranking systems are voluntary & aim to certify better performance
- Often require compliance checking with national regulations/standards for credit allocation.