SYNTEGRA GROUP



Building Compliance VS Performance

Presented by Umer Uzair CENG, MSc., MCIBSE, LCEA, BREEAM



UK Energy and Trends



Source; BEIS ECUK Table 1.01

Thousand tonnes of oil equivalent (ktoe)







201 Bishopsgate



450003: Crawley Library Sector: Office Benchmark category: General Office Sector: Sport & Leisure Benchmark category: Cultural activities



450028: Woodland Trust Headquarters Sector: Office Benchmark category: General Office



450035: Castle Hill Primary School Assembly / Dining Hall

Sector: Education Benchmark category: Schools and seasonal public buildings



450088: Ore Valley Business Centre (Lochgelly Business Centre)

Sector: Office Benchmark category: General Office



	Design data 35.7 kg CO ₂ /m ² /yr	Actual data 160.1 kg CO ₂ /m ² /yr	
	Design data 20.0 kg CO ₂ /m ² /yr	Actual data 61.2 kg CO ₂ /m ² /yr	
	Design data 70.7 kg CO ₂ /m ² /yr	Actual data 68.4 kg CO ₂ /m ² /yr	
	Design data 58.9 kg CO ₂ /m ² /yr	Actual data 92.2 kg CO ₂ /m ² /yr	
s	Design data 26.1 kg CO ₂ /m ² /yr	Actual data 43.2 kg CO ₂ /m ² /yr	

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What is Performance GAP?

Building performance modelling





Evaluating operational energy performance of buildings at the design stage





Buildings rarely perform as well as their designers predicted – energy consumption can be as much as double what was expected, so annual energy costs can also be doubled. This difference has become known as the performance gap.

Dr. Andy Lewry- BRE Global Bridging the Performance Gap

There is a mismatch between the expectations around the performance of new buildings and the reality of the utility bills.

This difference between expected and realised energy performance has come to be known as the 'performance gap'

Building Compliance VS Performance





CIBSE TM54





Energy Modelling Compliance Parameters

Energy models are generally used at the design stage to compare design options and to check compliance with Building Regulations. These energy models are not intended as predictions of energy use, but are sometimes mistakenly used as such.

The reality of predicted and actual energy consumption





Unregulated Energy Use plug loads, external lighting, server rooms, security, etc

Extended Use extra occupancy & operating hours

Other special uses or functions

Actual Energy Use





Part L Energy Modelling Compliance or Performance



Figure 1 Comparison of ADL2A calculations and operational performance for a case study



Energy Consumption by End Use [kWh/m²]

	Actual	Notional
g	28.31	38.34
9	0	0
ry	5.89	7.44
g	39.37	11.81
ter	192.62	127.2
nent*	12.31	12.31
**	199.42	184.8

Energy used by equipment does not count towards the total for calculating emissions.
* Total is net of any electrical energy displaced by CHP generators, if applicable.





<u>EPC Compliance or Performance</u>

EPC provides a theoretical reflection of energy performance of the asset at standardised conditions.

It demonstrates energy efficiency of a particular building, based on the performance potential of the building fabric and its associated services such as heating, cooling, ventilation and lighting.

Annual energy use for a designed building is estimated and compared with the energy use of a comparable 'notional' building on the basis of pre set design conditions.

Energy modelling for level 3 and 4 buildings are based upon Simplified Building Energy Modelling (SBEM) Methodology.

Building Compliance VS Performance







Buildings similar to this one could have ratings as follows 58 If newly built If typical of the existing stock



BREEAM Compliance VS Performance

Table 4 Minimum BREEAM standards by rating level

	Minimum standards by	BREEAM rating level			
BREEAM issue	Pass	Good	Very Good	Excellent	Outstanding
Man 03: Responsible construction practices	None	None	None	One credit (Considerate construction)	Two credits (Considerate construction)
Man 04: Commissioning and handover	None	None	None	Criterion 10 (Building User Guide)	Criterion 10 (Building User Guide)
Man 5: Aftercare	None	None	None	One credit (Seasonal commissioning	One credit (Seasonal commissioning)
Ene 01: Reduction of energy use and carbon emissions	None	None	None	Five credits	Eight credits
Ene 02: Energy monitoring	None	None	One credit (First sub-metering credit)	One credit (First sub-metering credit)	One credit (First sub-metering credit)
Wat 01: Water consumption	None	One credit	One credit	One credit	Two credits
Wat 02: Water monitoring	None	Criterion 1 only	Criterion 1 only	Criterion 1 only	Criterion 1 only
Mat 03: Responsible sourcing of materials	Criterion 1 only	Criterion 1 only	Criterion 1 only	Criterion 1 only	Criterion 1 only
Wst 01: Construction waste management	None	None	None	None	One credit
Wst 03: Operational waste	None	None	None	One credit	One credit
LE 03: Minimising impact on existing site ecology	None	None	One credit	One credit	One credit





<u>SKA Compliance VS Performance</u>

Good Practice Measures for Offices

Good practice measures for retail

D49

D50

E01

E02

E04

D52

E05

E07

E06

D03

E11

D51

D05

E25

E09

E08

E26

E10

D67

D53

P01

D65

D66

E24

D54

D55

P09

Energy & CO₂ Energy & CO₂ Reduce lighting energy in use P10 P11 Reduce small power in use 2 Energy efficient lighting D01 D02 Lighting controllability 5 E01 Lighting controls 6 E02 Energy efficient lamps 10 23 24 E05 Energy efficient heat pumps 18 25 E07 Pipework insulation 27 27 E08 Tenancy sub-metering 28 29 E04 Energy efficient light fittings 29 32 E06 30 HVAC zone controls 34 E09 End-use sub-metering 41 37 IT and comms room energy consumptior E22 41 44 43 D03 Energy efficient HVAC 48 46 D66 Energy modelling 49 48 D53 Electrical management 59 66 E11 68 Efficient boilers 67 D04 69 Daylighting 69 E24 71 Energy efficient hand-dryers 70 85 D05 71 Energy efficient DHW 99 Reduce fit-out energy use 86 P01 103 105 P09 Display Energy Certificates (DECs) 107 111



Good Practice Measures for Higher Education

Energy and CO₂

Lighting controllability – front of house	1	P10	Reduce lighting energy in use
Lighting controllability - back of house	2	P11	Reduce small power energy in use
Lighting controls	3	D01	Energy efficient lighting
Energy efficient lamps	4	E04	Energy efficient light fittings
Energy efficient light fittings	5	D02	Lighting controllability
Customer entrance	6	E02	Energy efficient white LEDs
Energy efficient heat pumps	7	E01	Lighting controls
Pipework insulation	8	E28	Secondary window treatments
HVAC zone controls	9	E05	Energy efficient heat pumps
Energy efficient HVAC	10	E06	HVAC zone controls
Energy efficient boilers	11	D05	Energy efficient DHW
Energy efficient kitchen ventilation	12	E11	Sources of primary energy
Energy efficient DHW	13	E22	IT comms room energy consumption
Sub-metering for commercial kitchens	14	D51	Energy efficient specialist ventilation
Electricity sub-metering	15	E30	Fume cupboard selection and operation
I nermal sub-metering	16	D52	Energy efficient entrances
Component AMT	17	E26	Energy efficient commercial service c
Display alazina	18	E29	Passive design approach
Electrical management	19	E24	Energy efficient hand-dryers
Reduce fit-out energy use	20	D54	Energy efficient lifts
External signage	21	E09	End-use sub-metering
Energy modelling	22	E25	Sub-metering for specialist areas
Energy efficient hand-drvers	23	D04	Improvement in davlighting
Energy efficient lifts	24	E08	Thermal sub-metering
Energy efficient escalators	25	D03	Energy efficient HVAC
Display Energy Certificates (DECs)	26	D66	Energy modelling
	27	P01	Reduce fit-out energy use







WELL Compliance VS Performance

Light					
53	Visual lighting design				
54	Circadian lighting design				
55	Electric light glare control				
56	Solar glare control				
57	Low-glare workstation design				
58	Color quality				
59	Surface design				
60	Automated shading and dimming controls				
61	Right to light				
62	Daylight modeling				
63	Daylighting fenestration				
Fitness					
64	Interior fitness circulation				
65	Activity incentive programs				
66	Structured fitness opportunities				
67	Exterior active design				
68	Physical activity spaces				
69	Active transportation support				
70	Fitness equipment				
71	Active furnishings				
Comfo	rt				
72	Accessible design				
73	Ergonomics: visual and physical				
74	Exterior noise intrusion				
75	Internally generated noise				
76	Thermal comfort				
77	Olfactory comfort				
78	Reverberation time				
79	Sound masking				
80	Sound reducing surfaces				
81	Sound barriers				
82	Individual thermal control				
83	Radiant thermal comfort				











How to Bridge Performance GAP?

Building performance modelling





Evaluating operational energy performance of buildings at the design stage





Complex Energy Modelling

Adopt more complex energy modelling such as dynamic simulation models at early design stage,

- 1. Part L Compliance Energy Model on the basis of NCM methodology and normal weather profiles
- 2. Design Model on the basis of future occupancy profiles, operating hours and complex weather profiles.

Review controls strategy including

- 1. Lighting
- 2. Ventilation
- 3. Heating
- 4. Comfort Cooling/ Air Conditioning
- 5. Mixed Mode Operation
- 6. Night Time Cooling

Unregulated Loads (Misc.)

- 1. Other Systems energy load
- 2. Lifts/ Escalators etc.
- 3. IT/Data centres

methodology and normal weather profiles es, operating hours and complex weather profiles.





<u>CIBSE TM54 – Design Stage Extensive Modelling</u>



Figure 5 Methodology for evaluating operational energy use at the design stage



The following questions are suggested to help to structure the interview:

- What are the intended hours of operation of the building?
- Are existing occupancy profiles available for the current workplace?
- Will there be requests for extended hours of operation?
- What happens on long holidays e.g. Easter weekend?
- When will the building be cleaned?
- If the building is cleaned in the evening, will the cleaners be responsible for turning the lights off?
- Are there any out-of-hours operational requirements?
- Can the energy use be reduced during out-of-hours operation (e.g. night set-back, turning-off display lighting when shelf-stacking etc.)
- Will the security arrangements require lights on and plant/equipment to be
- Will process equipment that is not required (e.g. it equipment) be switched off outside of occupancy hours?

Will the building use require re-stocking, preparation for catering, maintenance etc., which would require plant to be running outside regular occupancy hours?









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<u>CIBSE TM54 – Design Stage Extensive Modelling</u>

Building management and related training, commissioning, controls and metering have a major impact on how long and at what intensity services or equipment operate each day

Occupant density beyond compliance assumptions can affect energy usage but can be difficult to estimate or verify

Operating hours beyond those assumed in compliance calculations, including intermittent occupancy, are not required to be considered for compliance

Special functions are specialist activities that can cause a major increase in energy consumption such as lifts, swimming pools, medical equipment, etc

Small power equipment including plug loads and other electrical equipment are excluded from the compliance stage totals

ICT including servers, telecoms, security, etc. can have a major impact on energy use

Assumptions and simplifications in the energy model (e.g. weather, infiltration etc.) can increase or reduce enegy use

Part L calculations include heating, hot water, cooling, ventilation and fixed lighting at set occupancy and opening hours

Figure 2 Reasons why Approved Document L2A compliance calculations differ from operation energy use (based on a CarbonBuzz diagram (http:// www.carbonbuzz.org))



Part L model versus TM54 estimate versus actual



Figure 3 Results of applying the methodology to the case study building





EPC/ DEC Performance Rating Tool

Major Differences between EPC & DEC?

Display Energy Certificate (DEC) is based upon operational rating of assessed building, records the actual energy usage from a building over the course of a year, and benchmarks them against buildings of similar use.

The two ratings presents different aspects of a building's total energy performance, however both of them has significance.

The anticipated design quality of the building at EPC stage has large impact on the carbon emissions identified under DEC. However, DEC also includes unregulated energy such as lifts, actual behaviour of building users, impact of weather profile of assessed year, occupancy profiles, management and maintenance of building systems and controls.

In reality the difference between EPC and DEC is the indicator of Performance Gap. This is where the real building performance differs from the anticipated one.

Building Compliance VS



Display Energy Certific How efficiently is this buildir

LONDON BOROUGH OF NEWHAM St. Stephens Primary School Whitheld Road LONDON E6 1A8

This certificate indicates how much energy is being used to open the energy actually used in the building including for lighting, heat represents performance indicative of all buildings of this type. Th document Display Energy Certificates and advisory reports for p ww.gov.uk/government/collections/energy-performance-pertific

Energy Performance Operational

This tells you how efficiently energy has been used in the building not represent actual units of energy consumed; they represent con efficiency. 100 would be typical for this kind of build





Ε 101-125 F 126-150 G Over 150

Less energy efficient

Technical Information This talk you technical interrution about how every is used in the building. Consumption data based on actual medec reactions Ham heating fael: Natural Gas Building environment: Heating and Natural Ventilation stal userbal floor area (mR; - 3453.2)

Asset Robing: Not available

	Heating	Destricity
Annual Energy Use (KWhimPysar)	80	-
Typical Energy Use (KWh/mPysar)	140	-
Energy from renewables	0%	2.9%



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<u>Useful Thoughts of bridging the Performance Gap</u>

- to identify compliance vs performance gap at early stage.
- Early engagement of end user to identify the intended use of the building.
- building controls.
- Practical analysis of the design building by using TM54 or other guidance tools.
- integration between sensors and manual overrides.
- tools showcase the Energy (KWh) use of the building alongside with Carbon (CO2) emissions.
- monitor, review and maintain the features to shrink the performance gap.





Undertake Complex Energy modelling including Part L Compliance modelling as well as Dynamic Simulation Modelling

Identify type of occupants who will be using the building, their likely energy demands and typical behaviour towards

Work closely with M&E designers to synchronise the modelling parameters with the proposed design, especially the

Review of as built performance through Display Energy Certificate or simply energy auditing tools. The use of these

Highlighting the importance of building maintenance to the end occupier (if known) and it is really important to













Thank you for listening



Umer Uzair Syntegra Consulting Ltd. Email: uu@syntegragroup.com

