



**INTEGRATED  
ENVIRONMENTAL  
SOLUTIONS**

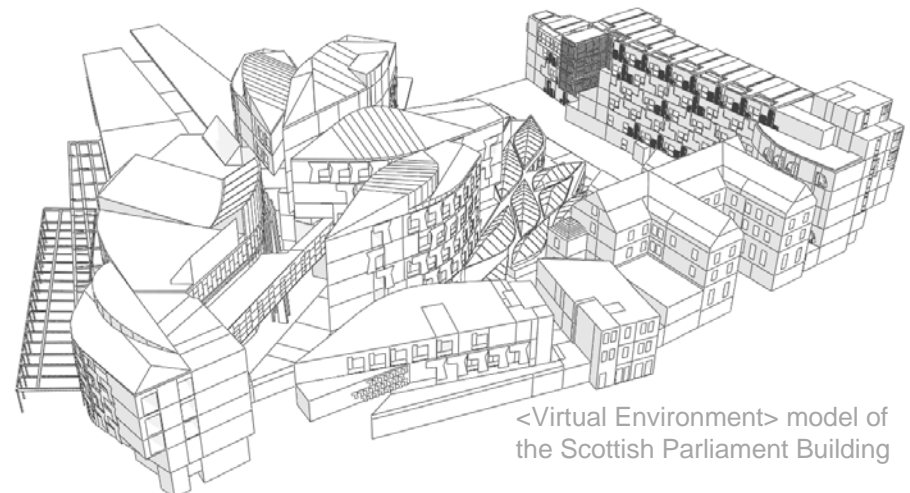
# Building Regulations 2010: Practical Implications

**Tracy Keegan  
IES Ltd**

Design, Simulate & Innovate with IES <Virtual Environment>

# Overview

- IES carried out pre-assessment analysis
- We will focus on changes to Part L2 (England/Wales) - this is applicable to Scottish Buildings aiming for BREEAM certification (EPC Rating)
- Results are based on a Dynamic Simulation (DSM) using IES's <Virtual Environment> software
- Representative building types: office, school, hospital



<Virtual Environment> model of the Scottish Parliament Building

# Calculation methods: SBEM v's DSM

## SBEM

- Compliance Tool
- Monthly heat balance (12 monthly time steps)
- Simple geometry
- 8 orientations
- Simple solar
- Simple HVAC
- Simple natural ventilation
- Simple renewable models
- Quick calculation (steady state)
- Only suitable for smaller schemes
- Not appropriate for Atria

## Dynamic Simulation (DSM)

- Design & Compliance Tool
- Dynamic sub hourly simulation (min 8760 hourly time steps)
- Complicated geometry (CAD links)
- Unlimited orientations
- Advanced solar penetration (vendor approaches differ)
- Detailed HVAC (vendor approaches differ)
- Detailed natural ventilation control
- Detailed renewables linked to weather data
- Detailed calculation will take longer
- Can be used on small schemes but more likely larger schemes

# Key L2A Changes & Implications

## Criterion 1

### ADL2A 2006

$$TER = C_{NOTIONAL} \times (1-IF) \times (1-LZC)$$

Notional Building represents minimum 2002 requirements.

Improvement Factor & Low Zero Carbon Factor introduce a required improvement in performance from the 2002 regulations.

### ADL2A 2010

$$TER = C_{NOTIONAL}$$

Notional Building is Target.

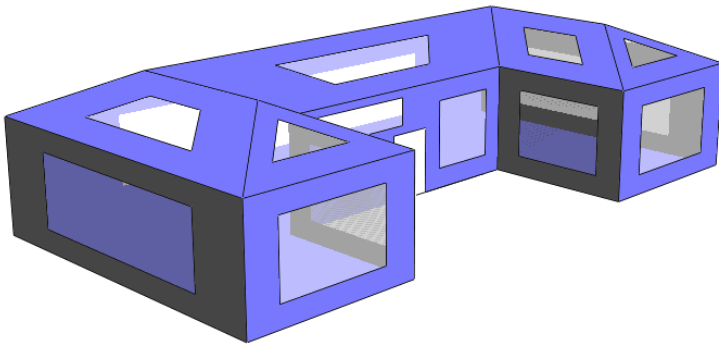
Significant changes in Notional Building make it easier to target key performance requirements needed to pass.

One of the main principles of the 2010 regulations is that if you build to the Notional Building in all respects you will pass.

# Key L2A Changes & Implications

## Notional Building - Form

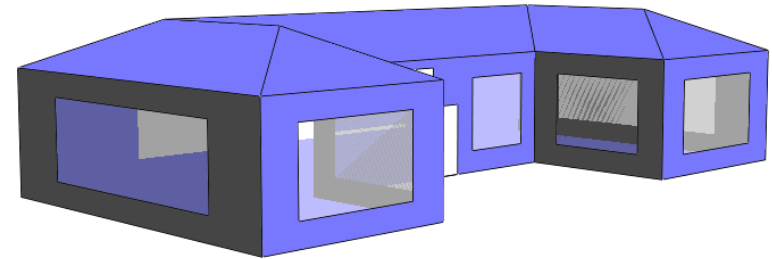
### ADL2A 2006



Notional Building has maximum permissible glazing area under 2002 prescription method.

This large amount of glazing often resulted in high cooling loads from solar gains in the Notional Building and increased heating loads due to increased fabric loss.

### ADL2A 2010



New for 2010 is the introduction of 3 Notional 'building' specifications to allow for variations in percentage glazing.

Notional Building falls into either a Sidelit, Toplit or No Glazing Category based on the assigned Building Activity type.

A notional room will have either windows OR rooflights but not both.

# Key L2A Changes & Implications

## Notional Building - Constructions

### ADL2A 2006

Table 1: U-values in the notional building	
Exposed element	U-value (W/m <sup>2</sup> K)
Roofs <sup>1</sup> (irrespective of pitch)	0.25
Walls	0.35
Floors and ground floors (subject to paragraph 28 below)	0.25
Windows, roof windows, rooflights, curtain walling and pedestrian doors <sup>2</sup>	2.2

Notional Building U-Values equal to minimum U-Values required

Air Permeability = 10 m<sup>3</sup>/m<sup>2</sup>.h @ 50Pa

### ADL2A 2010

Element	Sidelit/No glazing	Toplit specification
Roof U-value (W/m <sup>2</sup> .K)	0.15	0.24
Wall U-value (W/m <sup>2</sup> .K)	0.18	0.30
Floor U-value (W/m <sup>2</sup> .K)	0.21	0.22
Window & door U-value (W/m <sup>2</sup> .K)	1.6	1.8

Notional Building U-Values lower than Criterion 2 U-value requirement.

Although Notional Building U-values have been reduced, these do not form limiting figures for Criterion 2

If actual building only meets minimum Criterion 2 requirements further improvements will likely be needed elsewhere to offset better Notional Building.

Air Permeability = 5 m<sup>3</sup>/m<sup>2</sup>.h @ 50Pa

# Construction U-Value Requirements

## Part L2A – England & Wales

Construction Element	Criterion 2 U-Value Requirement 2006 (W/m <sup>2</sup> .K)		Criterion 2 U-Value Requirement 2010 (W/m <sup>2</sup> .K)
	Weighted Average	Worst Individual Element	Worst Individual Element
Roof	0.25	0.35	0.25
Wall	0.35	0.7	0.35
Curtain Wall	2.2	3.3	2.2
Floor	0.25	0.75	0.25
Window / Rooflights	2.2	3.3	2.2
Pedestrian Door	2.2	3	2.2
High Usage Entrance Doors	6	6	3.5
Vehicle Access Door	1.5	4	1.5
Roof Ventilators	6	6	3.5

# Construction U-Value Requirements

## Section 6 – Scotland (New Builds)

Construction Element	Section 6 U-Value Requirement 2006 (W/m <sup>2</sup> .K)		Section 6 U-Value Requirement 2010 (W/m <sup>2</sup> .K)	
	Weighted Average	Worst Individual Element	Weighted Average	Worst Individual Element
Roof	0.25	0.35	0.2	0.35
Wall	0.3	0.7	0.27	0.7
Floor	0.25	0.7	0.22	0.7
Window / Rooflights	2.2	3.3	2	3.3
Doors	2.2	3.3	2.2	3.3

# Key L2A Changes & Implications

---

## Notional Building - Systems

### ADL2A 2006

- No Heat Recovery
- Heating Fuel either Nat. Gas or Oil
- Heating SCOP 73%, 78% or 83%
- Cooling SEER 1.67
- Central Mech. Vent SFP 2 W//s

### ADL2A 2010

- 75% Eff. Heat Recovery
- Same Heating Fuel as Actual Design
- Heating SCOP 88% or 82%
- Cooling SEER 3.5
- Central Mech. Vent SFP 1.8 W//s

Notional Building Systems significantly more efficient than previous Notional Building.

As same fuel in used in Notional Heating System less Credit is given to Low Carbon Systems (i.e. Biomass boiler)

# Key L2A Changes & Implications

## Fuel Factors

### ADL2A 2006

Fuel	Carbon Emission Factor (kg/kWh)
Nat. Gas	0.194
LPG	0.234
Oil	0.265
Biomass	0.025
Grid Electricity	0.422
Grid Displaced Electricity	0.568

### ADL2A 2010

Fuel	Carbon Emission Factor (kg/kWh)
Nat. Gas	0.206
LPG	0.251
Oil	0.306
Biomass	0.019
Grid Electricity	0.591
Grid Displaced Electricity	0.591

# Key L2A Changes & Implications

## Notional Building – Lighting Power

### ADL2A 2006

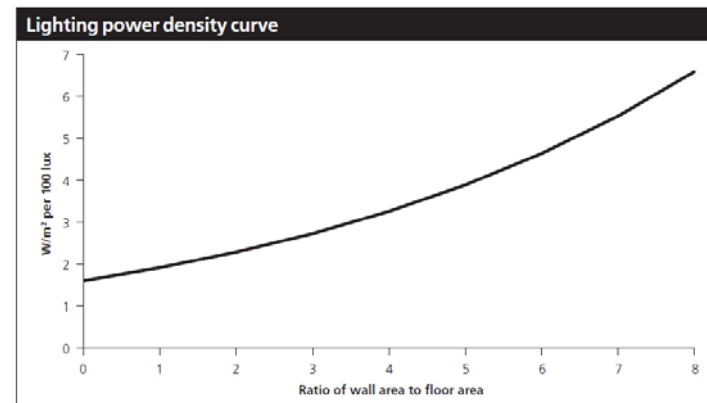
Office, Storage, Industrial  
3.75 W/m<sup>2</sup> per 100lux

All Other Spaces  
5.2 W/m<sup>2</sup> per 100lux

Notional Building lighting falls into one of two categories based on room activity.

Along with the design Lux level a lighting power is established for each space.

### ADL2A 2010



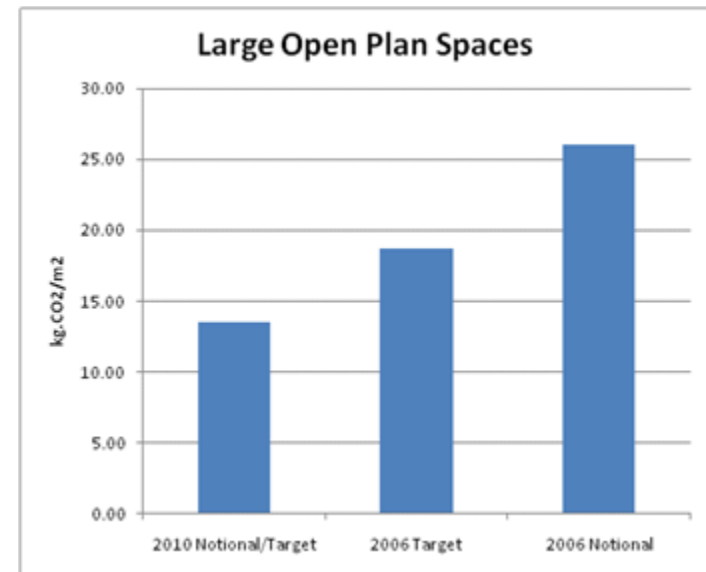
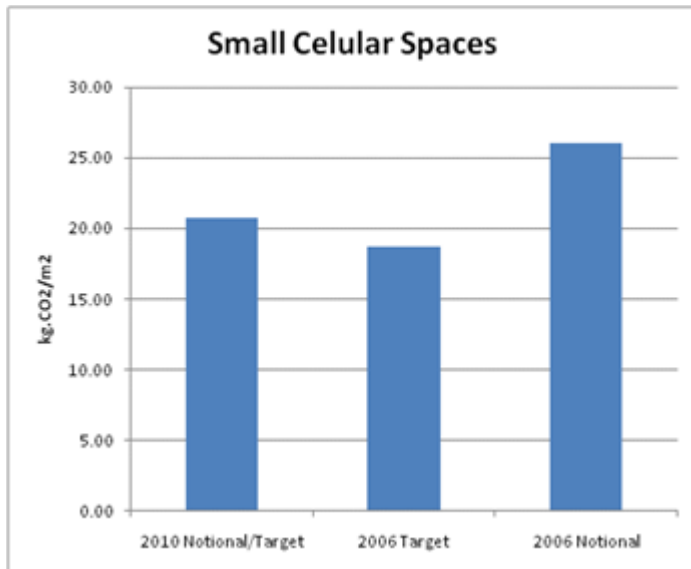
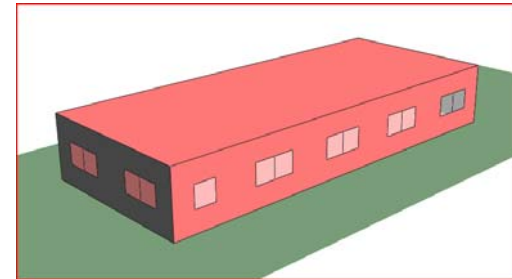
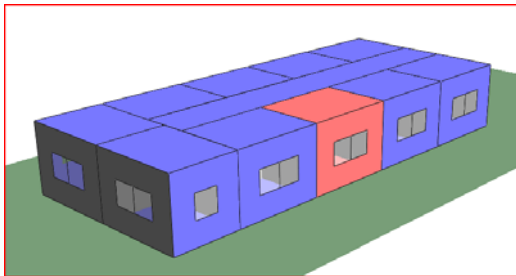
Notional Building uses Wall/Floor ratio to determine each zones Lighting Power Density.

Generally larger spaces will have a Lighting energy significantly lower than 2006 Notional Building.

As well as a reduced energy consumption there is a reduced internal gain resulting in a lower cooling load.

# Key L2A Changes & Implications

## Lighting Power Curve Implications



# Key L2A Changes & Implications

## Criterion 3

### ADL2A 2006

Typically based on Overheating assessment with DSY '05 weather Data.

Pass based on percentage of occupied hours exceeding a Operative Temperature of 28°C

Only Applicable to Naturally Ventilated Spaces (incl. mixed mode)

### ADL2A 2010

No longer an Overheating requirement.

Pass based on comparison of aggregated solar gain against a reference window.

Applicable to all spaces regardless of Space Conditioning Type

# Case Study – Office Building

## Building Summary

### Building Type: NCM Office

Location: London (LondonTRY)

Air Permeability:  $4 \text{ m}^3/\text{m}^2.\text{h}$  @ 50Pa

Main System: Centralised A/C

Lighting Gains: Office =  $3.75\text{W}/\text{m}^2/100\text{lux}$

### Constructions

Walls =  $0.35 \text{ W}/\text{m}^2.\text{K}$

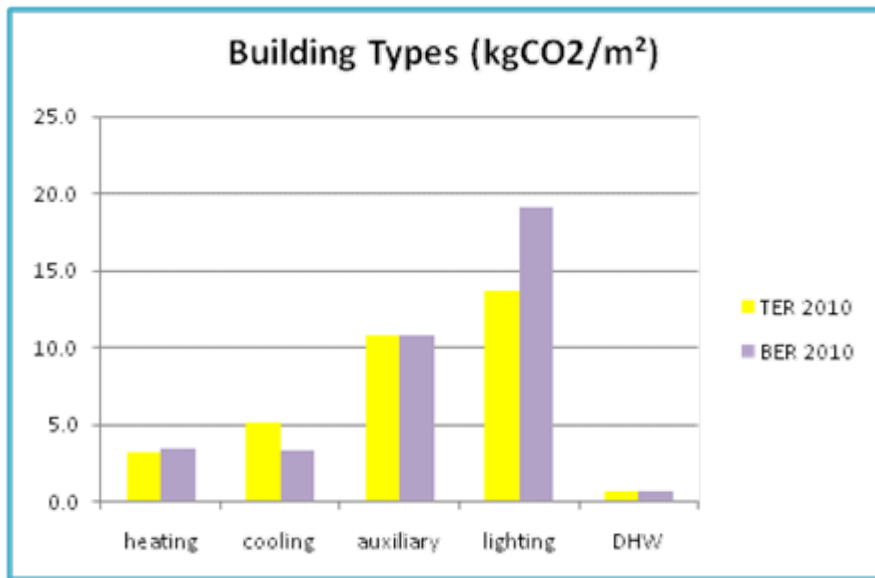
Ground Floor =  $0.25 \text{ W}/\text{m}^2.\text{K}$

Roofs =  $0.2 \text{ W}/\text{m}^2. \text{K}$

External Glazing =  $2.2 \text{ W}/\text{m}^2.\text{K}$

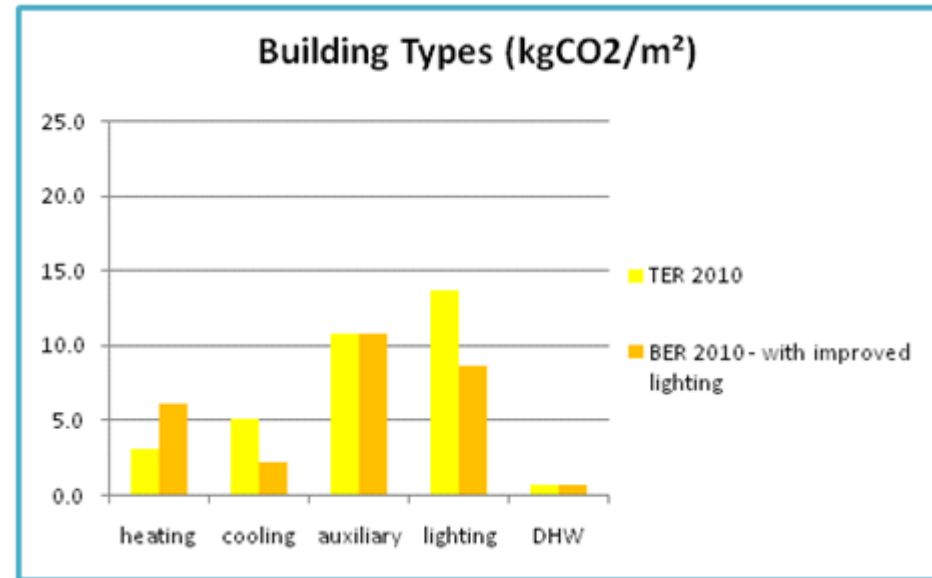
**Complies with TER 2006**

# Case Study – Results



**TER = 33.5**  
**BER = 37.4**

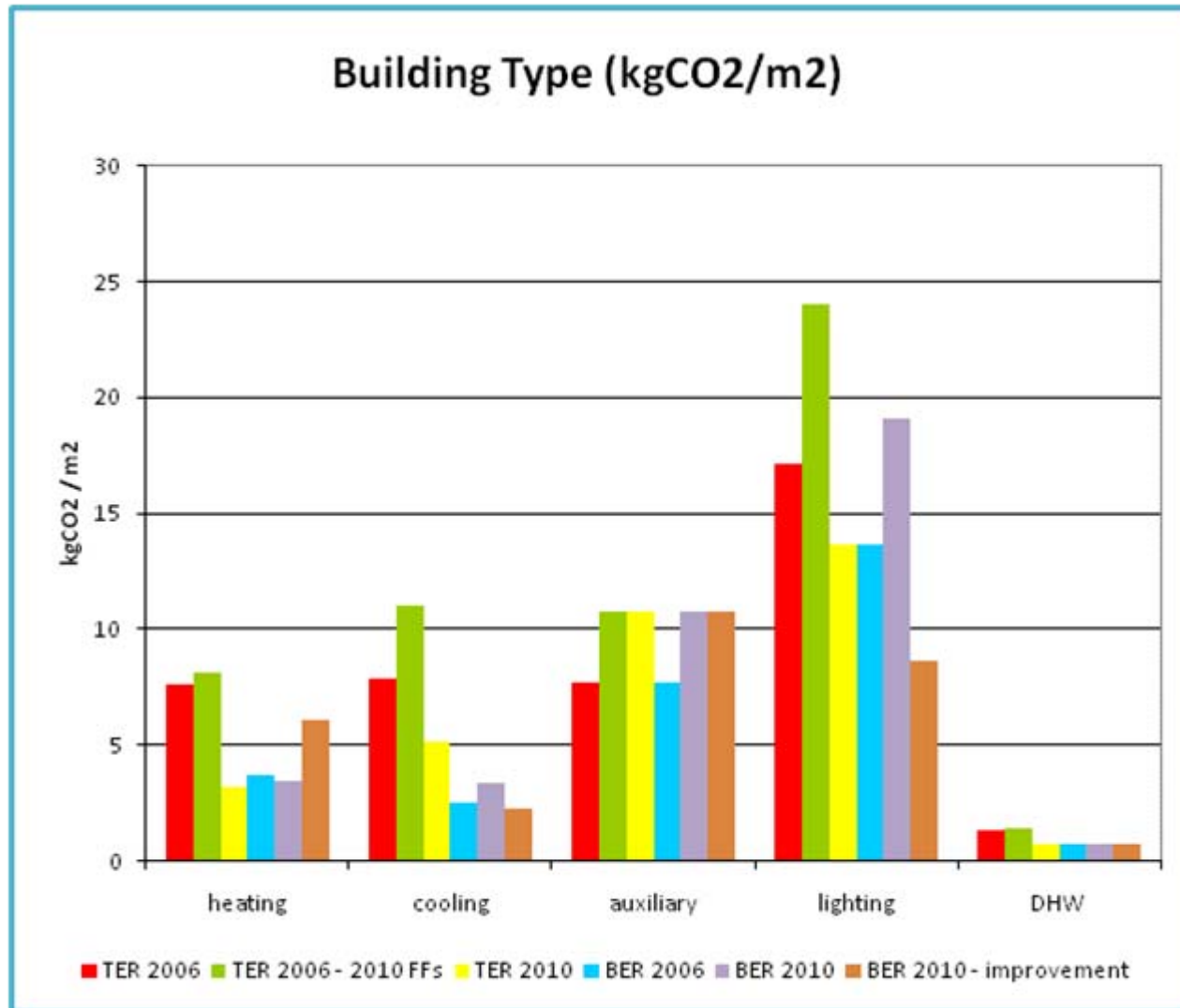
**-11.7%**



**TER = 33.5**  
**BER = 28.5**

**14.7%**

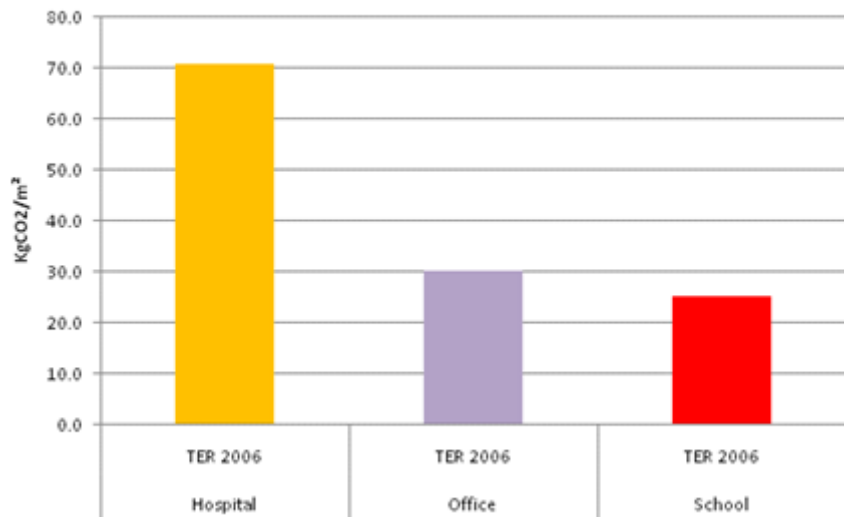
# Case Study - Results



# TER Comparison

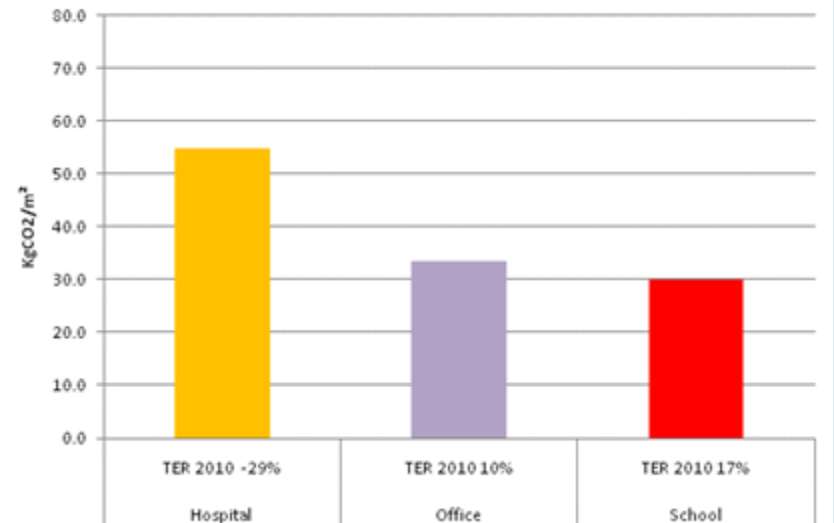
## ADL2A 2006

Building Types - TER Comparison



## ADL2A 2010

Building Types - TER Comparison



# Design Implications

---

- In general, the approach is different for each building type in the 2010 Regs. – software users will need to be aware that buildings will require a much more integrated design and clear stage by stage analysis
- Beating the Notional Building will be far more rigorous than the 2006 approach
- If an electric system is specified – this will only compete with the TER 2010 in highly insulated buildings. Otherwise fuel selection will have to be improved.
- There's less scope for rescue measures without Renewables. Fuel factor changes mean that the overall quality of building design is addressed with the hope that this leads to better building design.

# IES Approach to 2010 Regulations

*VE-Ware - FREE VE-SBEM Tool*

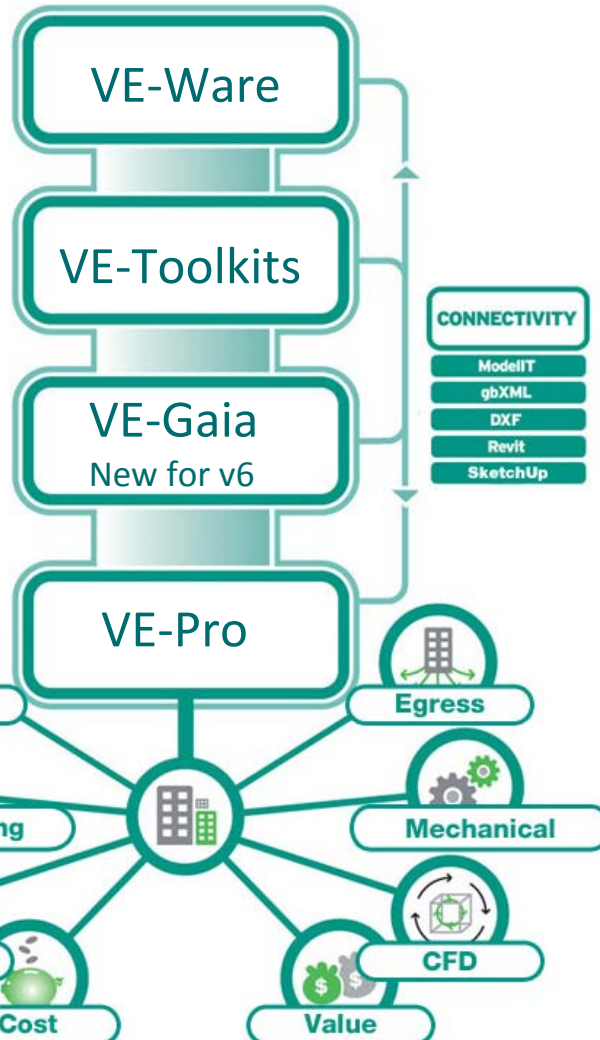
*VE-Toolkits - sustainable design iteration*

*VE-Gaia - Workflow & Quality Management*

*VE - DSM*

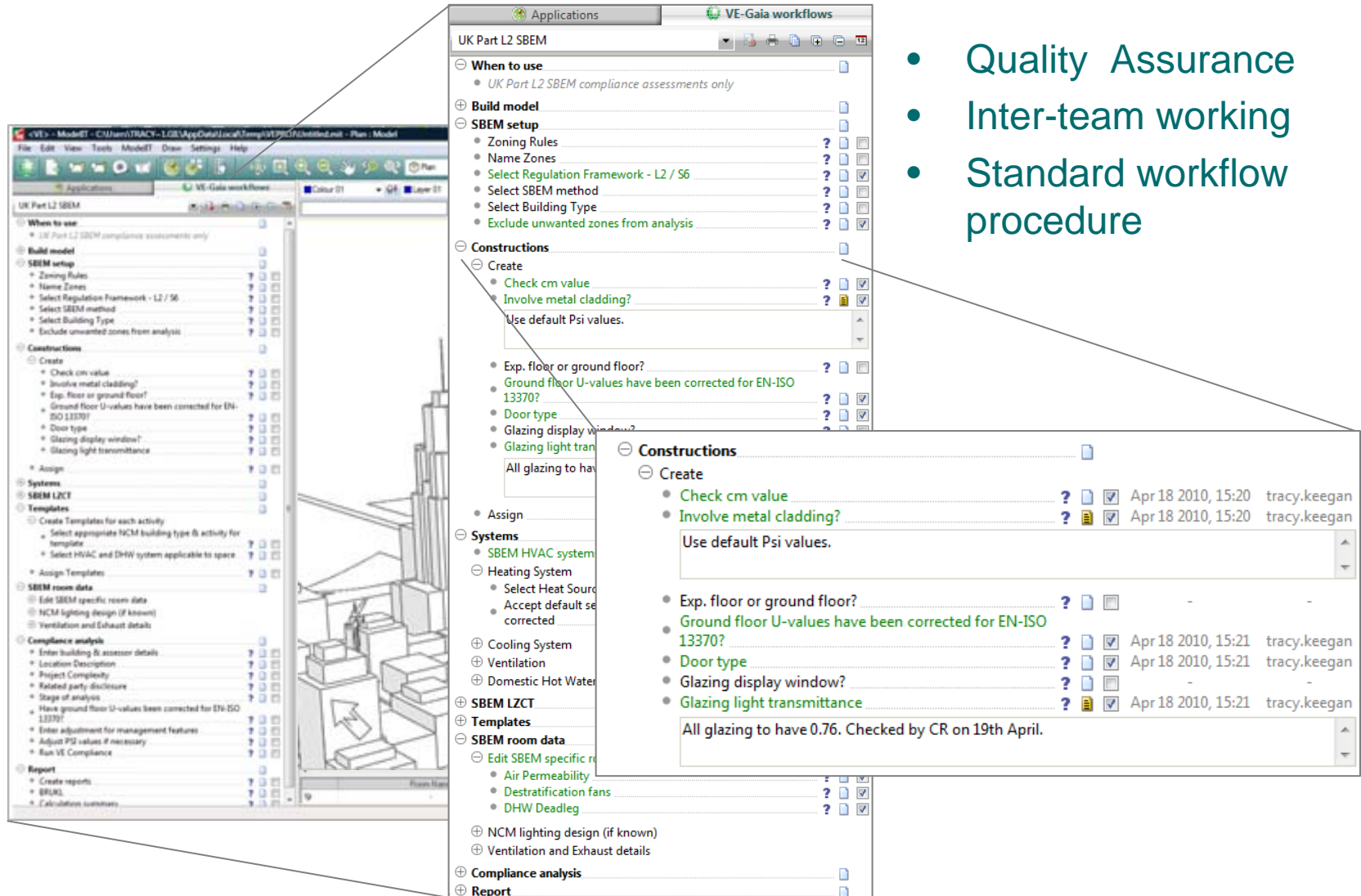


Design, Simulate & Innovate with IES <Virtual Environment>



# Compliance Workflow

- Quality Assurance
- Inter-team working
- Standard workflow procedure



**UK Part L2 SBEM**

- When to use
  - UK Part L2 SBEM compliance assessments only
- Build model
- SBEM setup
  - Zoning Rules
  - Name Zones
  - Select Regulation Framework - L2 / S6
  - Select SBEM method
  - Select Building Type
  - Exclude unwanted zones from analysis
- Constructions
  - Create
    - Check cm value
    - Involve metal cladding?
    - Use default Psi values.
    - Exp. floor or ground floor?
    - Ground floor U-values have been corrected for EN-ISO 13370?
    - Door type
    - Glazing display window?
    - Glazing light transmittance
    - All glazing to have 0.76. Checked by CR on 19th April.
- Systems
  - SBEM HVAC system
    - Heating System
      - Select Heat Source
      - Accept default setpoint corrected
    - Cooling System
    - Ventilation
    - Domestic Hot Water
- SBEM LZCT
- Templates
- SBEM room data
  - Edit SBEM specific room data
    - Air Permeability
    - Destratification fans
    - DHW Deadleg
  - NCM lighting design (if known)
  - Ventilation and Exhaust details
- Compliance analysis
- Report
  - Create reports
  - BRUK
  - Calculation summary

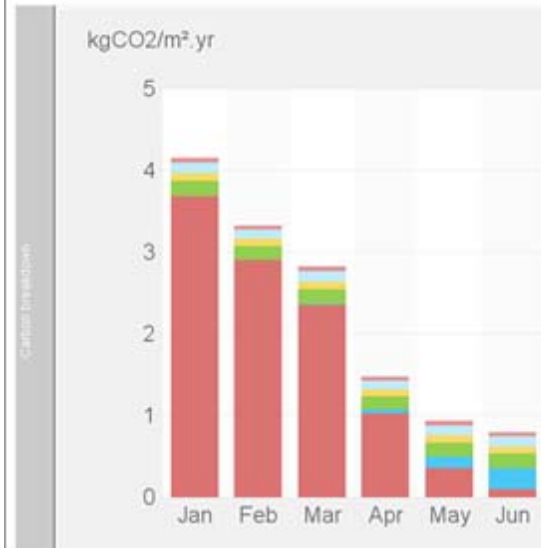
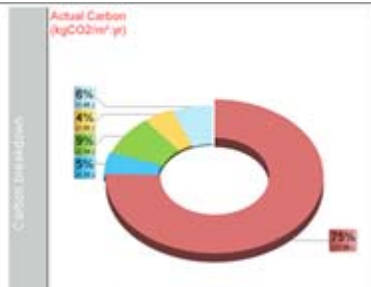
**Constructions - Create**

Task	Completion Date	Assignee
Check cm value	Apr 18 2010, 15:20	tracy.keegan
Involve metal cladding?	Apr 18 2010, 15:20	tracy.keegan
Exp. floor or ground floor?	-	-
Ground floor U-values have been corrected for EN-ISO 13370?	Apr 18 2010, 15:21	tracy.keegan
Door type	Apr 18 2010, 15:21	tracy.keegan
Glazing display window?	-	-
Glazing light transmittance	Apr 18 2010, 15:21	tracy.keegan

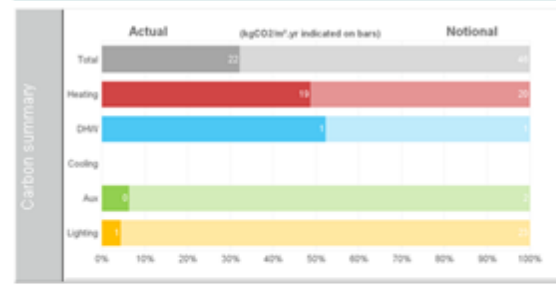
# Detailed Reportage

kgCO <sub>2</sub> /m <sup>2</sup> .yr	Heat	Cool	Aux	Lights	DHW	Renewables	Equip <sup>1</sup>
Jan	3.60	0.00	0.19	0.09	0.13	0.00	0.06
Feb	2.90	0.00	0.17	0.06	0.12	0.00	0.05
Mar	2.35	0.00	0.19	0.09	0.13	0.00	0.06
Apr	1.02	0.00	0.16	0.06	0.11	0.00	0.05
May	0.35	0.13	0.16	0.09	0.12	0.00	0.06
Jun	0.09	0.26	0.19	0.09	0.12	0.00	0.06
Jul	0.02	0.31	0.19	0.09	0.13	0.00	0.06
Aug	0.05	0.25	0.19	0.09	0.13	0.00	0.06
Sep	0.26	0.13	0.17	0.06	0.12	0.00	0.05
Oct	1.14	0.02	0.19	0.10	0.13	0.00	0.06
Nov	2.45	0.00	0.19	0.09	0.13	0.00	0.06
Dec	3.49	0.00	0.16	0.06	0.11	0.00	0.05
<b>Total</b>	<b>17.86</b>	<b>1.15</b>	<b>2.14</b>	<b>1.05</b>	<b>1.46</b>	<b>0.00</b>	<b>0.66</b>

<sup>1</sup>Equipment excluded when producing rating

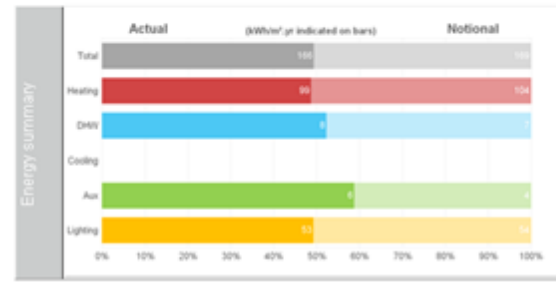


Carbon summary (kgCO<sub>2</sub>/m<sup>2</sup>.yr)



kgCO <sub>2</sub> /m <sup>2</sup> .yr	Actual	Notional
Heating	19.28	20.24
DHW	1.46	1.33
Cooling	0.00	0.00
Aux	0.12	1.79
Lighting	1.05	22.78
Renewables	(0.00)	(0.00)
<b>Total</b>	<b>21.92</b>	<b>46.14</b>

Energy summary (kWh/m<sup>2</sup>.yr)



kWh/m <sup>2</sup> .yr	Actual	Notional
Heating	99.39	104.33
DHW	7.53	6.85
Cooling	0.00	0.00
Aux	6.08	4.25
Lighting	52.60	53.98
Renewables	(0.00)	(0.00)
<b>Total</b>	<b>165.59</b>	<b>169.42</b>



Thank you ...

Questions?