“Bridging the performance gap” – understanding predicted and actual building operational energy

Name of Presenter: Dr Andy Lewry
Building Research Establishment

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» Research
» Consultancy
» Information services

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- BRE Group Ltd
- BRE Global Ltd
- BRE Trust
- BRE Building Research Establishment Ltd
Our Staff…

– Over 650 staff
– Over 400 professionally qualified
– Many national and international experts
– An integrated team of professionals

…people at the heart of our business
BRE’s experience in Energy Efficiency

- 40 years experience since 1970’s oil crisis
- 100 professionals working on all aspects of EE in construction
- Developed UK Government’s Best Practice programme
- Represent UK on concerted action
- Demonstration projects and testing on-site
- European and international standard work
- Modelling team producing UK Govnt software
- Rolled out experiences to several other countries – currently working in the Balkans rolling out the recast EBPD in Albania, Croatia, Serbia, FYI Macedonia, Kosovo and BiH - Federation.
- EcoShopping project in Hungary
- Training and CPD courses
- Certification schemes to accredit professionals
Bridging the building performance gap

– Building operators need to understand both predicted and actual building energy use
– Buildings rarely perform as well as their designers predicted
– Energy consumption and costs can be as much as double what was expected
– Difference has become known as the **performance gap**
Energy Performance Certificates - EPCs

- Asset rating
- Based on drawings and survey data
- Rated A-G
- Uses Simplified Building Energy Model (SBEM)
- iSBEM is free interface
- Provides recommendations on:
  - using the building more effectively;
  - cost effective improvements to the building; and
  - other more expensive improvements which could enhance the building’s energy performance
- Carried out by qualified, accredited non-domestic energy assessors
- Indicates building quality not operation under standardised “driving conditions”
EPCs

Energy Performance Certificate
Non-Domestic Building

56 London Road
LONDON
SW23 1HA

Certificate Reference Number:
01200-0003-0000-0029-0002

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: 93
- B: 86
- C: 73
- D: 63
- E: 51
- F: 40
- G: Over 150

Less energy efficient

Technical information

- Main heating fuel: Natural Gas
- Building environment: Air Conditioning
- Total useful floor area (m²): 2900
- Building complexity (NOS level): 3

Benchmarks

- Buildings similar to this new build have ratings as follows:
  - 93: If newly built
  - 113: If typical of the existing stock
Display Energy Certificates (DECs)

- Operational rating
- Based on meter readings
- Rated A-G
- Uses Operational Rating Calculation (ORCalc)
- Also provides recommendations
- Carried out by qualified, accredited non-domestic energy assessors
- Contains other factors such as unregulated loads (e.g. IT, plug-in appliances) or building user behaviour
- Indicates how building is managed
- Nearly always higher than the asset rating due to non-standard hours of operation, occupancy patterns and unregulated loads, such as IT and office equipment.

- Need both EPC and DEC to get complete picture
Display Energy Certificate

How efficiently is this building being used?

A Government Dept
12th & 13th Floor
Jubilee House
High Street
Ayrtown
A1 2CD

Certificate Reference Number:
1234-1234-1234-1234

This certificate indicates how much energy is being used to operate this building. The operational rating is based on meter readings of all the energy actually used in the building. It is compared to a benchmark that represents performance indicative of all buildings of this type. There is more advice on how to interpret this information on the Government's website www.communities.gov.uk/epbd.

Energy Performance Operational Rating

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

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

Total CO₂ Emissions

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO₂.

Previous Operational Ratings

This tells you how efficiently energy has been used in this building over the last three accounting periods.

Technical Information

This tells you technical information about how energy is used in the building.

- Main Heating Fuel: Gas
- Building Environment: Air Conditioned
- Total Useful Floor Area: 2977
- Asset Rating: 92

- Heating
- Electrical

<table>
<thead>
<tr>
<th>Energy Type</th>
<th>Heating Efficiency</th>
<th>Electrical Efficiency</th>
</tr>
</thead>
<tbody>
<tr>
<td>Annual Energy Use (GWh/year)</td>
<td>132</td>
<td>29</td>
</tr>
<tr>
<td>Typical Energy Use (GWh/year)</td>
<td>132</td>
<td>29</td>
</tr>
<tr>
<td>Energy from renewables</td>
<td>9%</td>
<td>29%</td>
</tr>
</tbody>
</table>

Administrative Information

This a Display Energy Certificate as defined in S2007.991 as amended.

Assessment Software: OR vg
Property Reference: 899123775612
Assessor Name: John Smith
Assessor Number: ABC12345
Accreditation Scheme: ABC Accreditation Ltd
Employer/Trading Name: Energy Watch Ltd
Employer/Trading Address: Alpha House, Bee Way, Birmingham, B3 1AA
Issue Date: 12 May 2007
Renewed Date: 01 Apr 2007
Valid Until: 31 Mar 2008

Related Party/Address: Energy Watch are contracted as energy managers. Recommendations for improving the energy efficiency of the building are contained in Report Reference Number 1234-1234-1234-1234.
Why bridge the gap?

- **To allow assessment** of energy savings and optimise with a view to cost reduction and optimise savings.

- **To Upgrade** – in future Landlords of commercial premises will be unable to let properties that fall below a set level of energy efficiency unless they make certain improvements. The level of energy efficiency will be demonstrated by the property’s EPC and the intention is for this to be set at EPC rating ‘E’. The rule is to be brought into force by 1st April 2018, by enacting it through the Energy Act of 2011.

- **To implement** the Energy Savings Opportunity Scheme (ESOS) - for the energy use of buildings, Display Energy Certificates (DECs) and UK Green Deal assessments can be used.
Resolving the issue

- **Whole-building energy benchmarking** - models energy use at the design stage and compares it directly with the in-use performance.

- **More complex modelling** - the extra detail provided by more complex modelling may provide more accuracy in the comparison process. However, it does not necessarily resolve the underlying problems posed by the need to model all building energy uses and address actual occupancy and services operation.

- **Analysing energy use at the design stage** – capture all end uses such as lighting, ventilation and small power, at the design stage and in use. TM54, *Evaluating operational energy use of buildings at the design stage*.

- **Combine EPCs/DECs using the Green Deal (GD) tool** – overcomes the issue with both ratings is that they are designed for compliance purposes and as a result are calculated using standard operating conditions for each building type and activity.
Asset & Operational energy calculation

How can it be defined ??

Perfectly managed building

Building & systems data, activities, temperatures, gains etc

Actual meter readings
Asset & Operational energy calculation

Sub-metered equipment energy

Actual meter readings

Perfectly managed building

Building & systems data, activities, temperatures, gains, equipment, etc
Asset & Operational energy calculation

- Asset improved building
- Perfectly managed building
- Poorly managed building

Accounts for different weather year and location, definition errors

- Improved asset performance
- Transposed asset performance
- Adjusted meter readings

x% saving

y% saving

Management score

y% saving
Asset & Operational energy calculation
Asset & Operational energy calculation

- Asset improved building
- Perfectly managed with equip
- Poorly managed building

- Improved asset performance
- Transposed asset performance
- Adjusted meter readings

- Asset saving
- Improved oper. performance
- Op.save

- Management score

Balance savings against costs
Asset & Operational energy calculation

Perfectly managed with equip

Adjusted meter readings

Poorly managed building

Have we taken account of impact of equipment appropriately?

Have we adjusted correctly for different weather year, location, occupancy, etc.?

Have we realistically modelled the poorly managed building?

Does the questionnaire ask the right questions and does the auditor answer it consistently?
Asset & Operational energy calculation

- Be aware of potential inaccuracies
  - Give confidence limits around crucial outputs

- Set up information gathering to refine in future
  - Use registry of information on all projects
  - Deduce statistical distribution of results
  - Feed back into calculation process to refine it
The Green Deal tool - overview:
New elements for iSBEM to include:

- A means to unlock some of the standardised assumptions currently prescribed by the Activity Database, so they can be tailored to the building’s actual operation
  ß occupancy hours, occupancy levels, design temperatures, etc.
- A more convenient means of testing and recording the impact of implementing different energy efficiency measures, individually and in combination
- A means to input actual fuel prices, so that approximate cost savings can be calculated as well as delivered energy and CO₂ reductions
- Normalising predicted energy use and savings against actual metered consumption
\( A_s \) = standardised Asset data
\( A_t \) = tailored Asset data
\( A_m \) = Asset data adjusted for current management
\( O' \) = final tailored and normalised Operational energy data
\( O \) = operational data
\( r \) = reliability of data (%)
<table>
<thead>
<tr>
<th>NAME</th>
<th>DESCRIPTION</th>
</tr>
</thead>
<tbody>
<tr>
<td>Replacement glazing</td>
<td>replace single glazed door with double glazed, change to wood frame with</td>
</tr>
<tr>
<td></td>
<td>thermally improved spacer</td>
</tr>
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</table>

**SAVINGS**

<table>
<thead>
<tr>
<th>SAVINGS</th>
<th>KwH/M2</th>
<th>£</th>
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</thead>
<tbody>
<tr>
<td>Asset</td>
<td>1.5</td>
<td>352.31</td>
</tr>
<tr>
<td>Operational</td>
<td>78.22</td>
<td>3484.99</td>
</tr>
</tbody>
</table>

**NAME**

<table>
<thead>
<tr>
<th>NAME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lighting systems, fittings and controls</td>
</tr>
</tbody>
</table>

**DESCRIPTION**

| Replace tungsten lamps to CFLs |
Producing the business case for investment in energy efficiency

—to save costs
  • 10% year-on-year increase in prices
  • 21% wastage

—to comply with legislation
  • Climate Change Agreements (CCAs)
  • CRC energy efficiency scheme
  • Strategic Report and Directors’ Report Regulations 2013

—to manage risk
  • ‘do nothing’ scenario
  • Security of supply issues
Baseline the organisation

- **Energy management** – easier if they have an energy management system.
- **Monitoring and Targeting (M&T)** - the old adage ”if you cannot measure it you cannot manage” – provide data
- **Energy audits** - “what can be done about it” call for an energy audit - investigate energy wastage and solutions.
- **The Green Deal Tool** - This tool can provide a snapshot of a building’s quality as an asset and how well it is operated; it then produces a report that reflects the potential operational savings and the measures needed to realise them.
- **Other factors** – timing, marginal costs, reduced maintenance and increased productivity.
Producing the business case

- Management risk
- Options to manage risk
- The “do nothing” scenario – what are the consequences
- **Financial metrics** – what do they mean and which ones are used
- **Know the rules of the game** - *What type of projects are acceptable to the organisation?* And *How are projects assessed?*
- **KISS** – Keep It Short and Simple - limit the proposal and business case to one page of A4
- **What are the benefits**
- **Present options** including the do nothing scenario – have more than one!
The pitch

- Simple messaging
- Know the audience
- Pick the appropriate media
- Make it sharp and to the point
- Remember the “punch line”
- Success stories
- Know your stuff
Conclusions

– Like Dragons Den you get only one chance
– You must talk their language
– Use their currency
– Produce a transparent case that stacks up including a “do-nothing” scenario
– Be ready to answer questions on the spot – do your homework!
– Have more than one option with reasons for the preferred option
Questions?

Dr Andy Lewry
lewrya@bre.co.uk
+44 (0)1923 66 4359
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