CIBSE POE and dynamic simulation seminar
London South Bank University, 13 December 2011

Design intent to reality:

Linking modelling to performance in use

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Linking modelling to performance in use

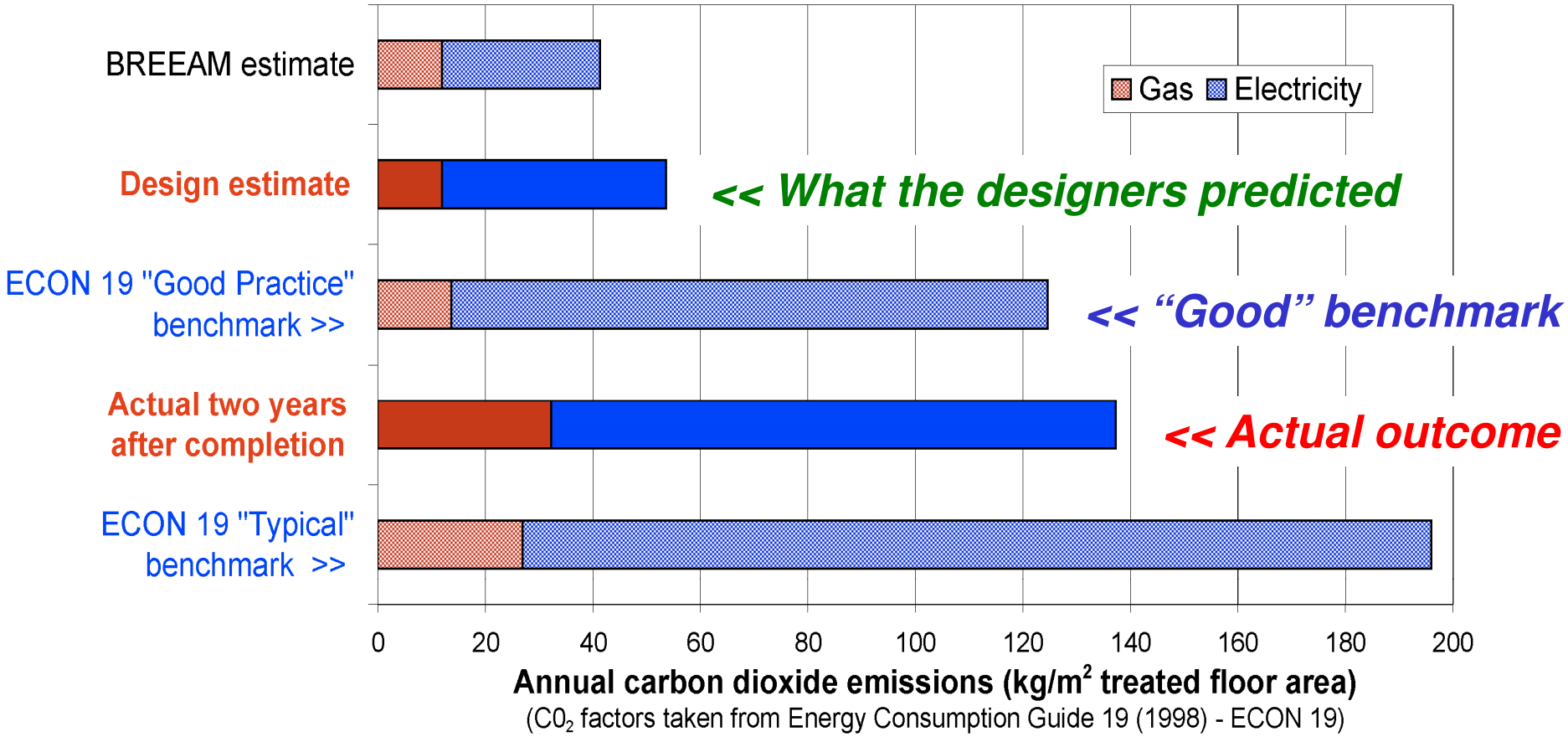
1. **How are we doing?**
2. **What can we do about it?**
3. **Changing the ways we do things**
4. **Improving two-way communication of energy and carbon performance**

1

HOW ARE WE DOING?

The Design-Performance Gap:
Identified in the 1990s

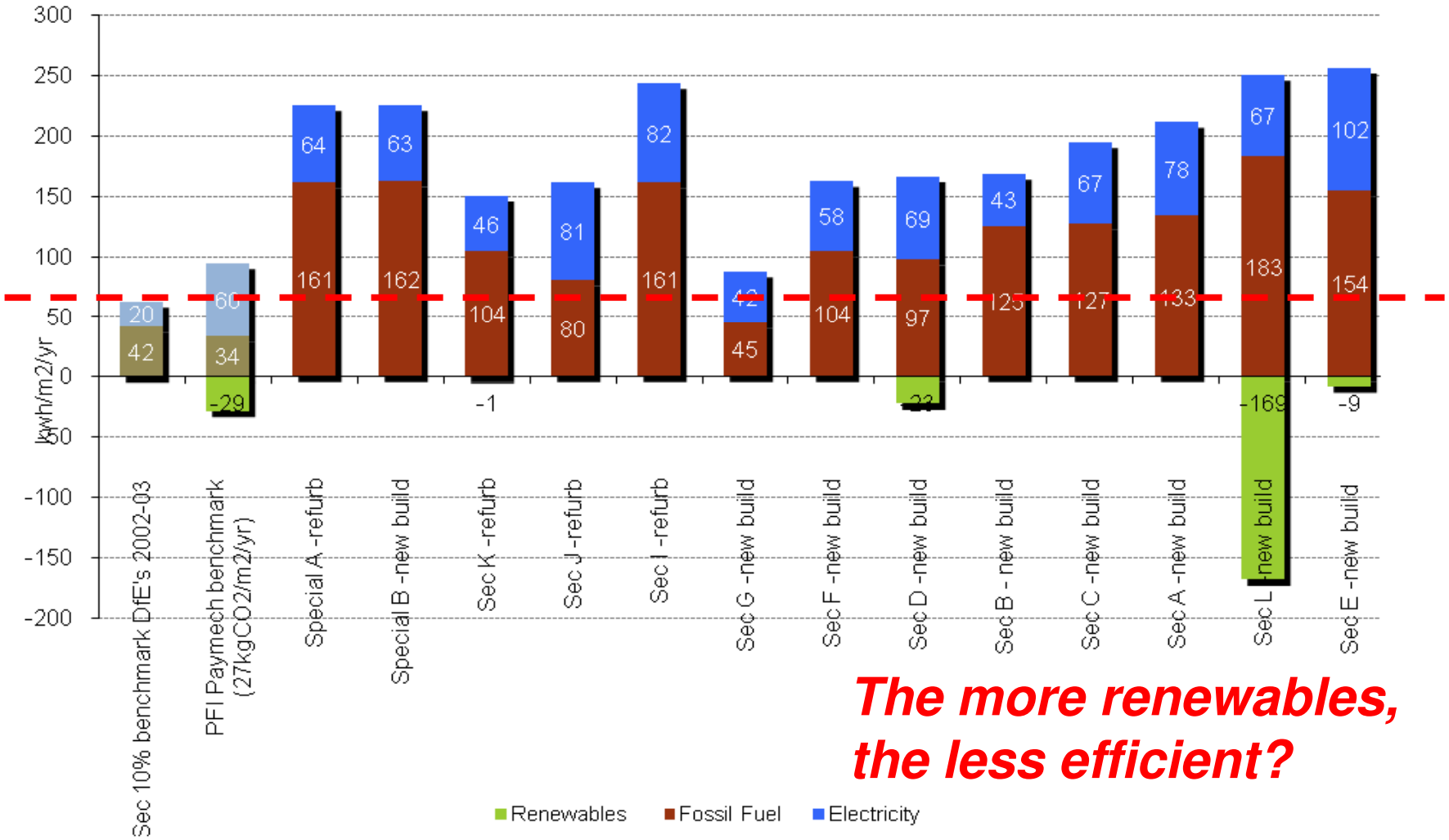
Data from the winner of the Green Building of the Year Award 1996



SOURCE: see discussion in S Curwell et al, *Green Building Challenge in the UK,* Building Research+Information 27(4/5) 286 (1999).

The Performance Gap:

Are we doing better now? ***New Secondary Schools.***

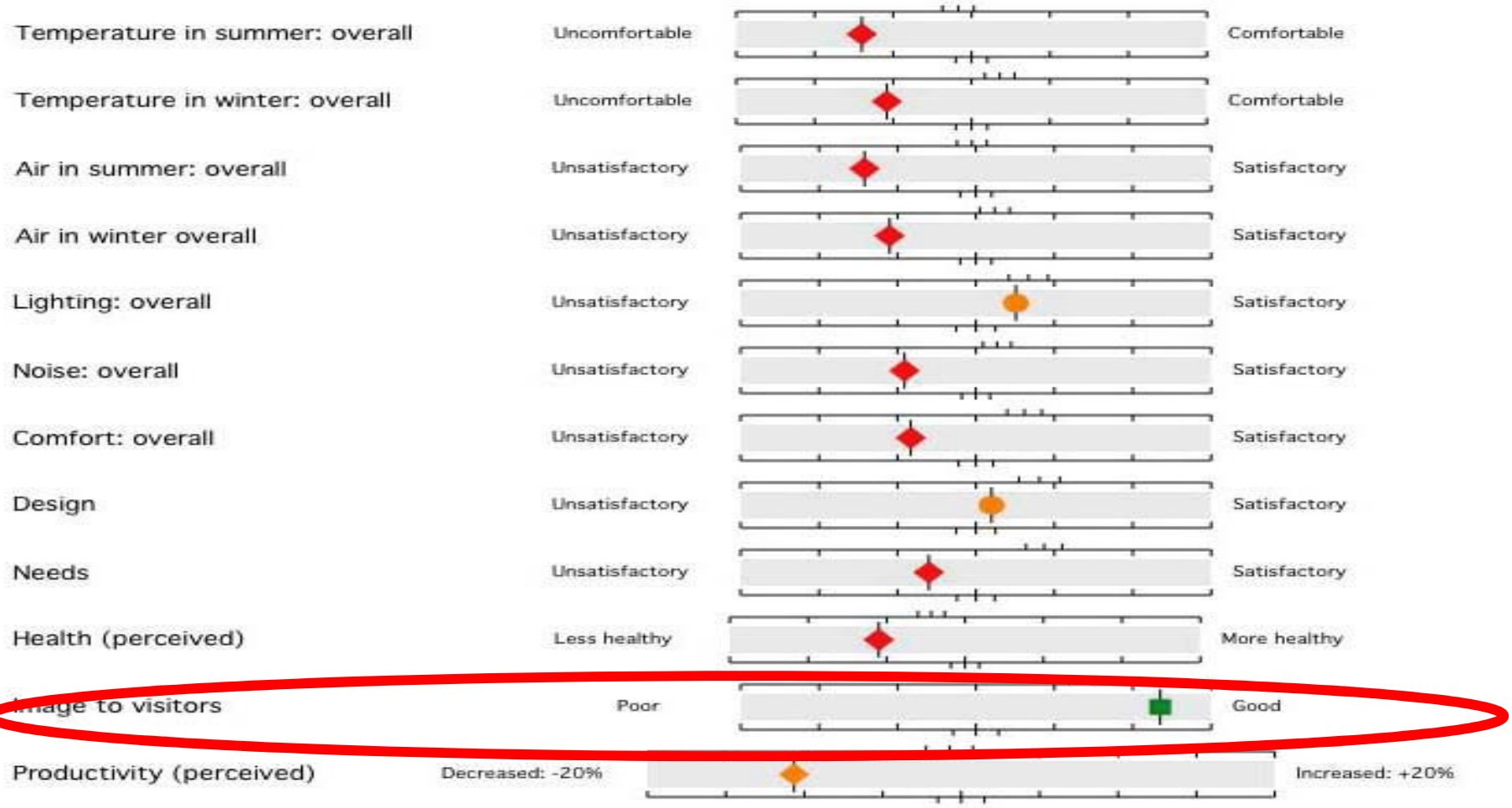


The more renewables, the less efficient?

SOURCE: *Private communication,* 2011

Performance gaps: Occupant satisfaction

Staff questionnaire survey, award-winning school

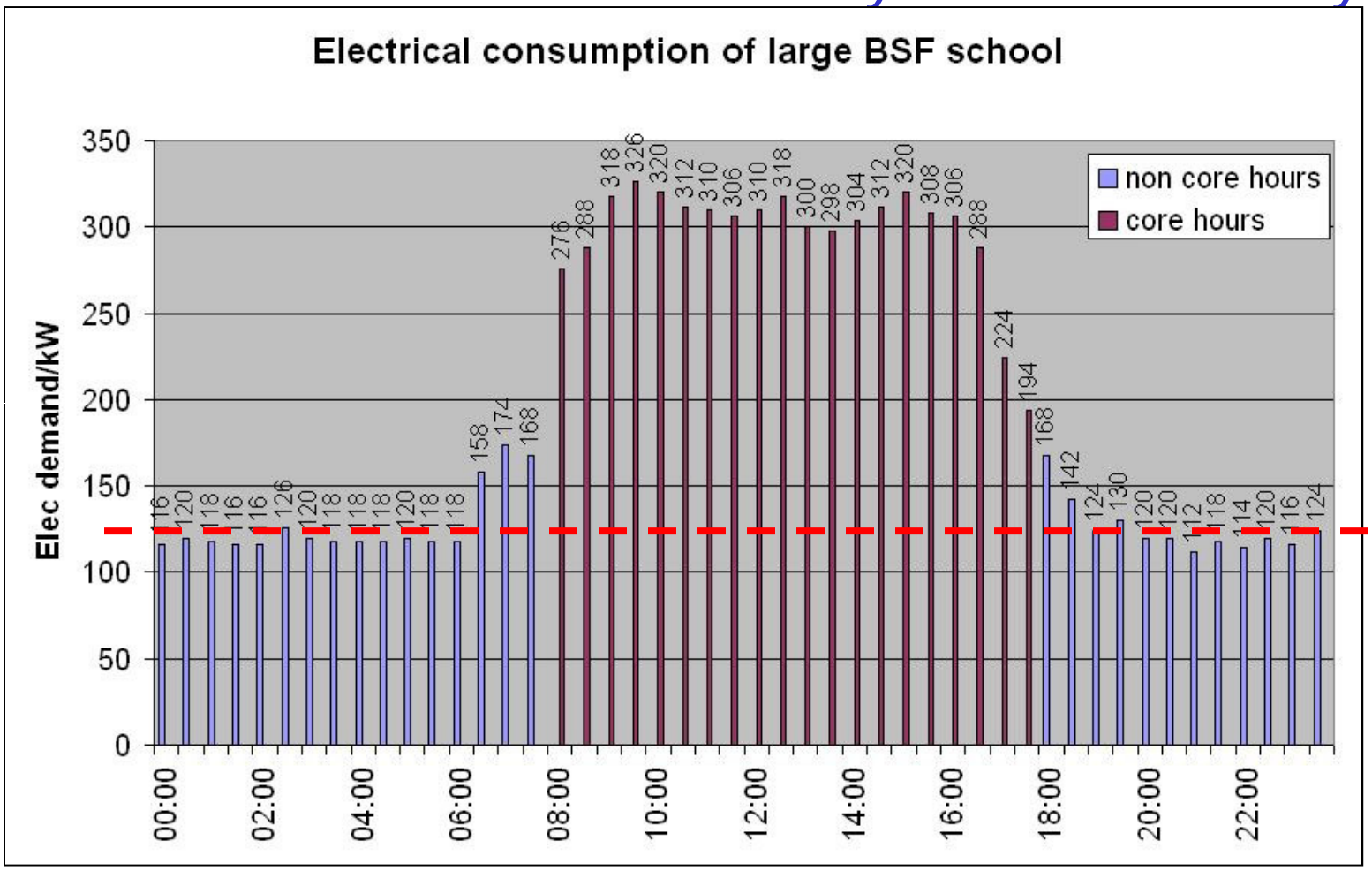


The judges may not experience what the occupants do!

SOURCE: *Unpublished occupant survey of an award-winning secondary school 2009.* Courtesy of Building Use Studies Ltd.

The electrical tail can often wag the dog

kWh/half hour in a recently-built secondary school



120 kW baseload: ca. 7 W/m² or 45 kWh/m² p.a. Equivalent to 60% of all lighting or 1000 PCs including screens. printers etc.

Breakdown of annual electricity use: *44% used between 0800-1800 on term time days*

56% (~£75,000) of electricity used at other times: ***14% term weekends, 26% term nights, 16% holidays***

SOURCE: Buro Happold (October 2009)

The Design-Performance Gap:
More examples

- You will hear specific examples in later papers: *most confirming generic problems, some with good news.*
- **In this introduction, I'll keep to the general issues.**

- We seem to be getting much better improving building performance in the virtual world than in the real one.
- Everybody needs to focus much more sharply on in-use performance: *Outcomes, not just Inputs and Outputs.*

"In theory, theory and practice are the same … in practice they aren't" … *SANTA FE INSTITUTE*

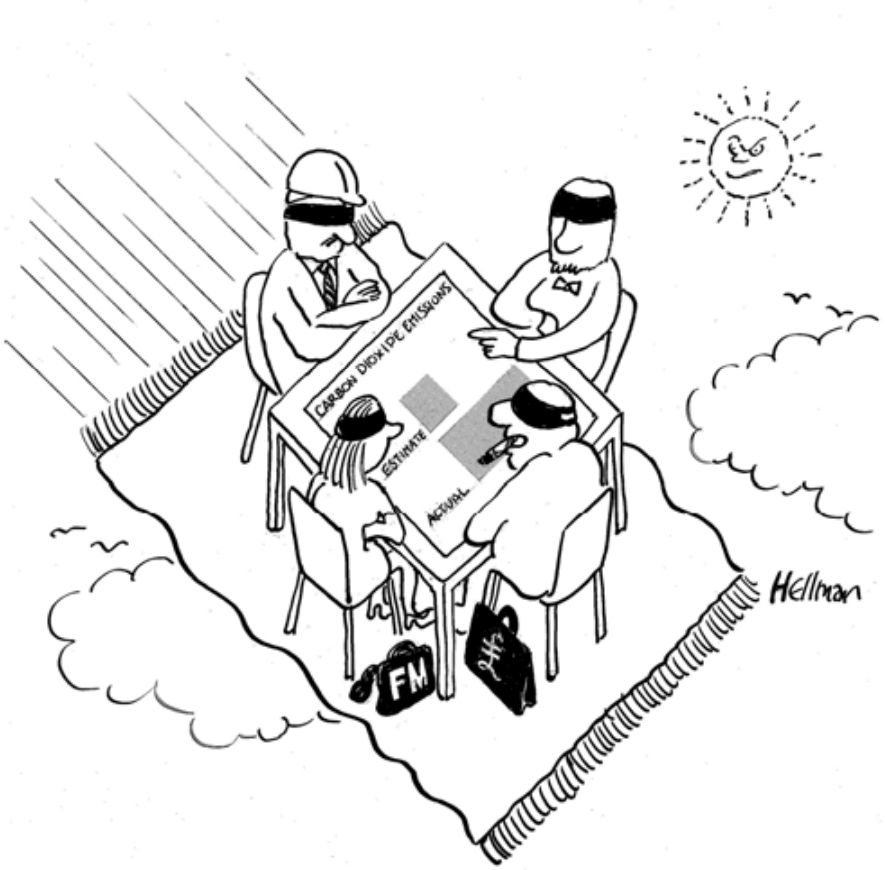
2

WHAT CAN WE DO ABOUT IT?

For most of the construction and property industry, *building performance in use has been another country …*

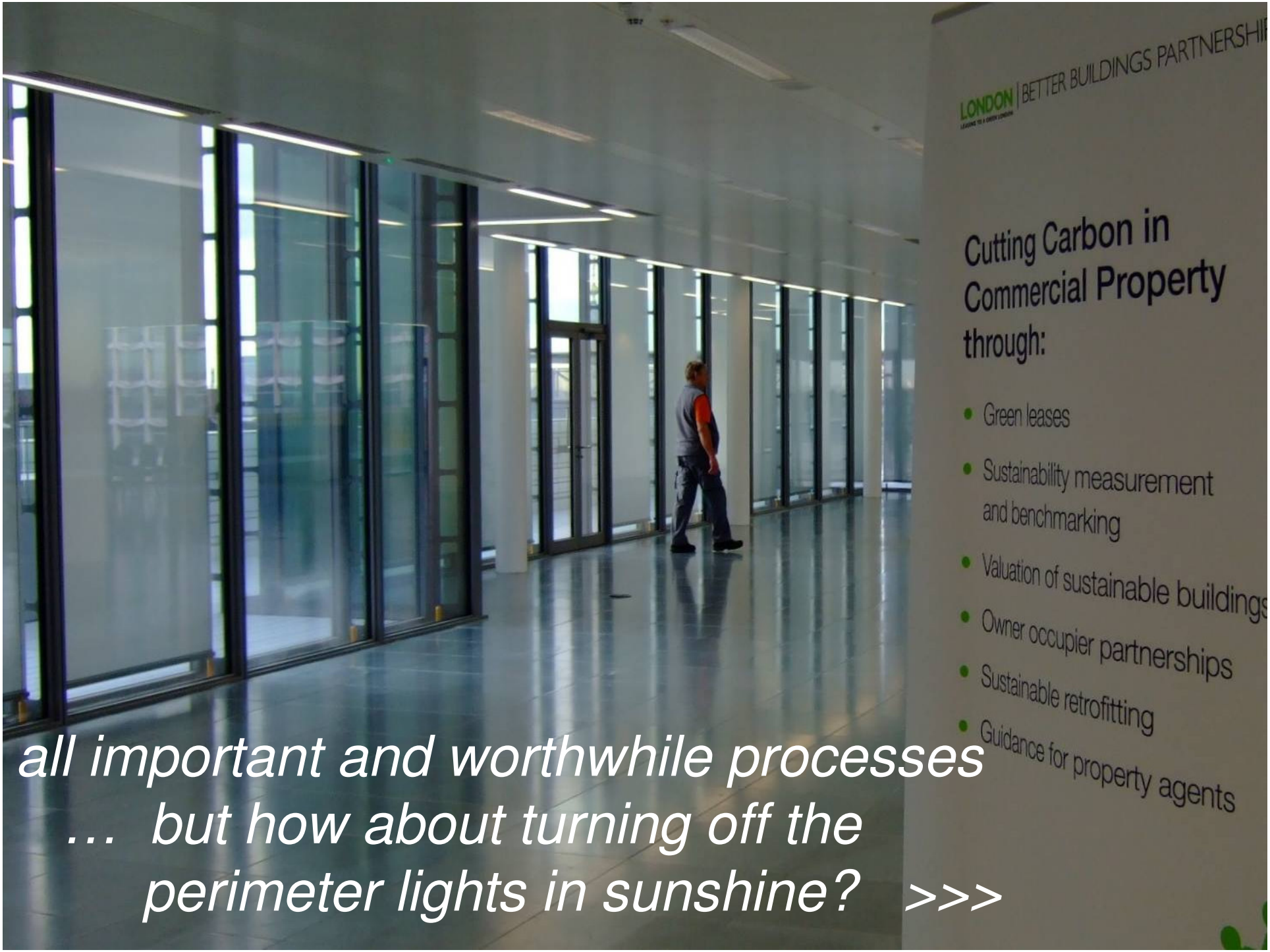
"designers seldom get feedback, and only notice problems when asked to investigate a failure."
ALASTAIR BLYTH
CRISP Commission 00/02

"I've seen many low-carbon designs, but hardly any low-carbon buildings"
ANDY SHEPPARD
Arup, 2009



We need to take much more account of the evidence under our noses.

SOURCE: Hellman cartoon for W Bordass, *Flying Blind,* Association for the Conservation of Energy & OXEAS (2001)



all important and worthwhile processes

… but how about turning off the perimeter lights in sunshine? >>>

Why haven't we tuned into outcomes?

- Not what clients have wanted, asked or paid the industry to do: *"hand over and walk away" is systemically embedded in standard procedures and contracts, so follow-through and feedback is not part of the standard offering*.
- Clients and government haven't set aside time and money for tuning-up after handover, *and have often preferred to bury bad news.*
- Rigid divisions between funding of capital and operational costs, *this is currently getting worse if anything, in spite of all the talk.*
- Policy emphasis on construction and cost, not performance in use, *even when feedback information has been revealing repeated problems.*
- Outsourcing technical expertise, research, property and building operation by central and local government has choked off previous sources of feedback *e.g. privatisation of works departments, PSA and the BRE.*
- "Post-Occupancy Evaluation" (POE) is a construction industry perspective, with handover seen the end, not the beginning! *Too often POE is also regarded as academic and mostly about occupant perceptions,* so UBT tends to prefer the terms *Building Performance Evaluation* and *Building Evaluation*.

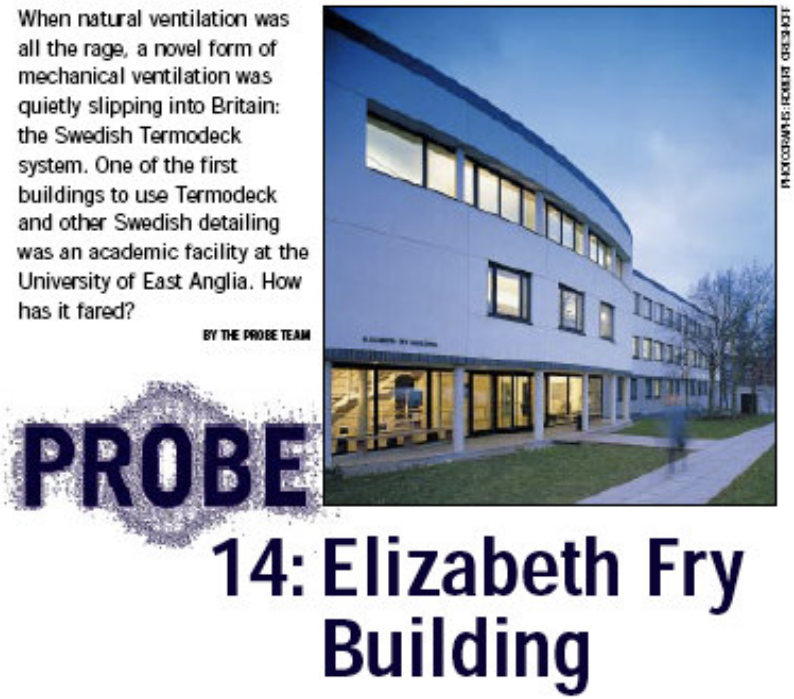
You can't tell if you have a good building

… *unless you find out how it is working*

Elizabeth Fry building has the last laugh

The story of the Elizabeth Fry building (AJ 23.4.98) contains a number of ironies. My favourite is that it didn't even make the shortlist of the Green Building of the Year Award in 1996.

DR ROBERT LOWE
Leeds Metropolitan University



LETTER TO ARCHITECTS' JOURNAL

The good performers don't necessarily impress the judges

SOURCE: The Elizabeth Fry Building and all the Probe reports can be downloaded from www.usablebuildings.co.uk

It's the process, not just the product

Factors for success at the Elizabeth Fry Building, UEA

- A good client.
- A good brief.
- A good team *(worked together before on the site).*
- Specialist support *(e.g. on insulation and airtightness).*
- A good, robust design, efficiently serviced *(mostly).*
- Enough time and money *(but to a normal budget).*
- An appropriate specification *(and not too clever).*
- An interested contractor *(with a traditional contract).*
- Well-built *(attention to detail, but still room for improvement).*
- Well controlled *(but only eventually, after monitoring and refit).*
- Post-handover support *(triggered by independent monitoring).*
- Management vigilance *(easier now, but must be sustained).*

But only its technical features were mentioned when a Royal Commission used it an exemplar

SOURCE: W Bordass et al, *Assessing building performance in use 5,* BR&I 29 (2), 144-157 (March-April 2001), Figure 6.

3

CHANGING THE WAYS WE DO THINGS

New non-domestic buildings:
What have we tended to find, for many years now?

- They often perform much worse than anticipated, *especially for energy and carbon, often for occupants, and with high running costs, and sometimes technical risks.*
- Design intent is seldom communicated well to users and managers. *Designers and builders go away at handover.*
- Unmanageable complication is the enemy of good performance. *So why are we making buildings technically and bureaucratically complicated in the name of sustainability, when we can't get the simple things right?*
- Buildings are seldom tuned-up properly. Controls are often a mess. *If we have more to do, what chance do we have?*
- Modern procurement systems make it difficult to pay attention to critical detail. ***A bad idea when promoting innovation.***
- ***"The British spare no expense to get something on the cheap".*** ***… NIKOLAUS PEVSNER***

KEEP IT SIMPLE, DO IT WELL, FOLLOW IT THROUGH, TUNE IT UP, CAPTURE THE FEEDBACK

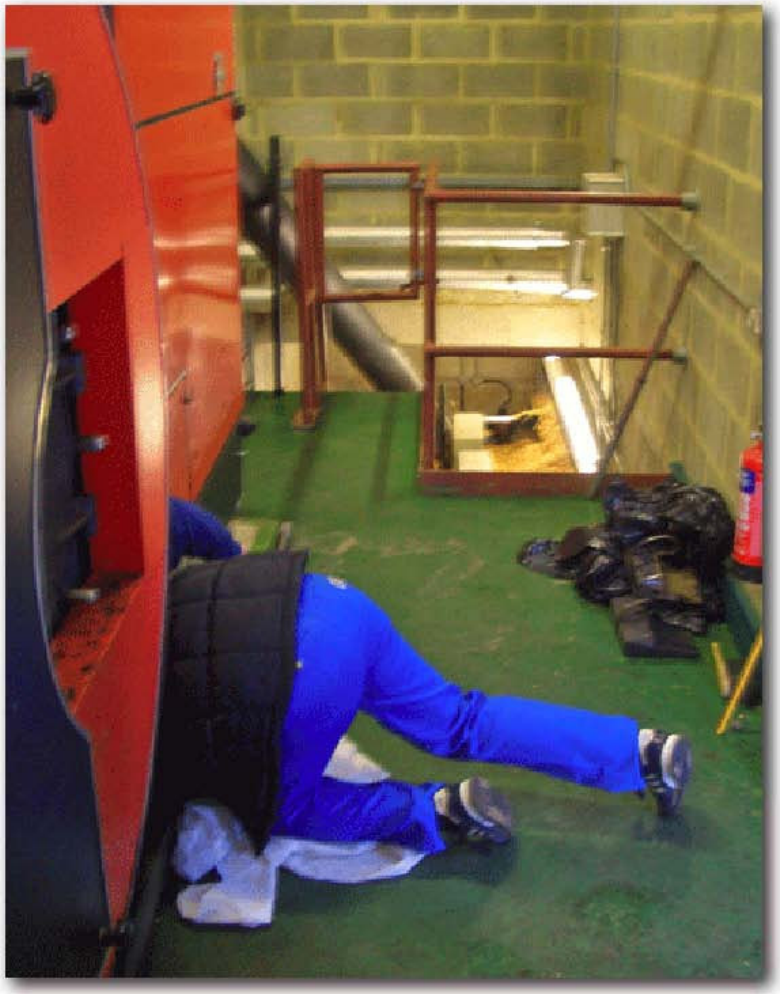
SOURCE: For more information, go the Probe section of www.usablebuildings.co.uk

Why are there Performance Gaps?

Expectations not set realistically, and not managed through the process

- Design estimates often don't count everything: *only normal services in typical spaces (e.g. so-called "regulated loads" subject to building regulations), no night loads, perfect control, some or all occupier loads often omitted or underestimated (for energy, if not for connected loads).*
- Modelling tends to be a black art, used largely to compare, not predict in context; *and the results are seldom communicated transparently.*
- Slippage during design development: *changes in client requirements, fabric, services, value (vandal?) engineering. Consequences not reviewed.*
- Slippage during construction and commissioning: *negotiations, substitutions, build quality, systems, controls, delays.*
- Changes after completion: *fitout changes and clashes, no follow-through, no fine tuning or training, unintended outcomes.*
- Spilt responsibilities: *novation, developer/owner, landlord/manager/tenant, outsourcing.* Principal/agent problems. Procurement of controls.
- Unintended consequences: *technical surprises, management shortcomings, undetected waste, controls problems, poor user interfaces, night loads, systems defaulting to ON. Unmanageable complication.*

Don’t provide what occupiers can’t afford to manage



Modelling can make things too complicated in the name of efficiency.

We need to tune in to outcomes … *and fast!*

- Clients and government are getting more interested in performance.
  We need to set realistic expectations and manage them through the design and production process, and into use.
- Sustainability requires much more focus on achieved performance.
  And not just of the regulated items designers currently regard as being their responsibility - this misses many opportunities.
- We are being asked to jump through many hoops - we need to understand what really adds value and what needs to be improved.
  For the planet's sake, we can't afford to invest in the wrong things.
- Things are changing fast, so we need rapid feedback on how well they are actually working. We have to learn as much as possible from our own experiences, and to share them with others.
  We no longer have the time to rely on somebody else doing it for us.

Changing our attitudes
Re-defining the practitioner's role

- Construction-related institutions require their members to understand and practice sustainable development.
- How can we do this, unless we understand the consequences of our actions?

SO HOW ABOUT?

- Changing our attitudes to the nature of the job.
- Focusing on in-use performance outcomes.
- Making follow-through, feedback and POE/BPE routine.
- Closing the feedback loop – rapidly and effectively.
- Making much more immediate and direct links between research, practice and policymaking.
- Routinely reviewing model predictions against performance in use.

Getting more sense into procurement
Soft Landings can help

1. **Inception and Briefing**
   Appropriate processes, better relationships.
   Assigned responsibilities, including client.
   Well-informed targets related to outcomes.
2. **Design and construction**
   Including ***expectations management.***
3. **Preparation for handover**
   Better operational readiness.
4. **Initial aftercare**
   Information, troubleshooting, liaison, fine tuning, training.
5. **Longer-term aftercare**
   monitoring, review, independent POE, feedback and feedforward.

Runs alongside any construction process

Downloadable free
from www.usablebuildings.co.uk
and www.softlandings.org.uk

BSRIA *is hosting a UK industry group.*

SOURCE: downloadable from www.usablebuildings.co.uk and www.bsria.org.uk

Link modelling to *Expectations Management* during project delivery

Why good buildings go bad while some are just born that way

Dr Paul Bannister, Exergy Australia Pty Ltd

ABSTRACT

With the realisation that climate change is not going to be resolved by inaction or unrealised promises, the issue of actual building performance has become focal in today's commercial buildings sector. With this has come the genuinely problematic issue of delivering and operating buildings at levels of efficiency higher than have been achieved before.

While some argue that good design is all, those involved in operating buildings are generally aware that the issues of delivering and operating high-efficiency buildings are somewhat more complex. A building that has a good theoretical performance may not perform well in practice, while many lesser buildings may be easier to operate and improve.

In this paper, a range of issues that cause apparently well designed buildings to perform poorly are explored, with particular emphasis on the issues affecting base buildings under the Australian Building Greenhouse Rating scheme. These issues include items that can be seen as the responsibility of various participants in the supply chain, as well as many that are the product of numerous such participants. It is identified that delivering and operating high-efficiency buildings is a complex and multifaceted problem that requires a holistic rather than reductionist view of the building process. Some guidelines for more reliable delivery of efficient buildings are also provided.

SOURCE: Ecolibrium, the Journal of the Australian Institute of Refrigeration, AC and Heating, 24-32 (February 2009)

4

IMPROVING TWO-WAY COMMUNICATION OF ENERGY AND CARBON PERFORMANCE

Houston, we have a problem …

communicating energy and carbon performance

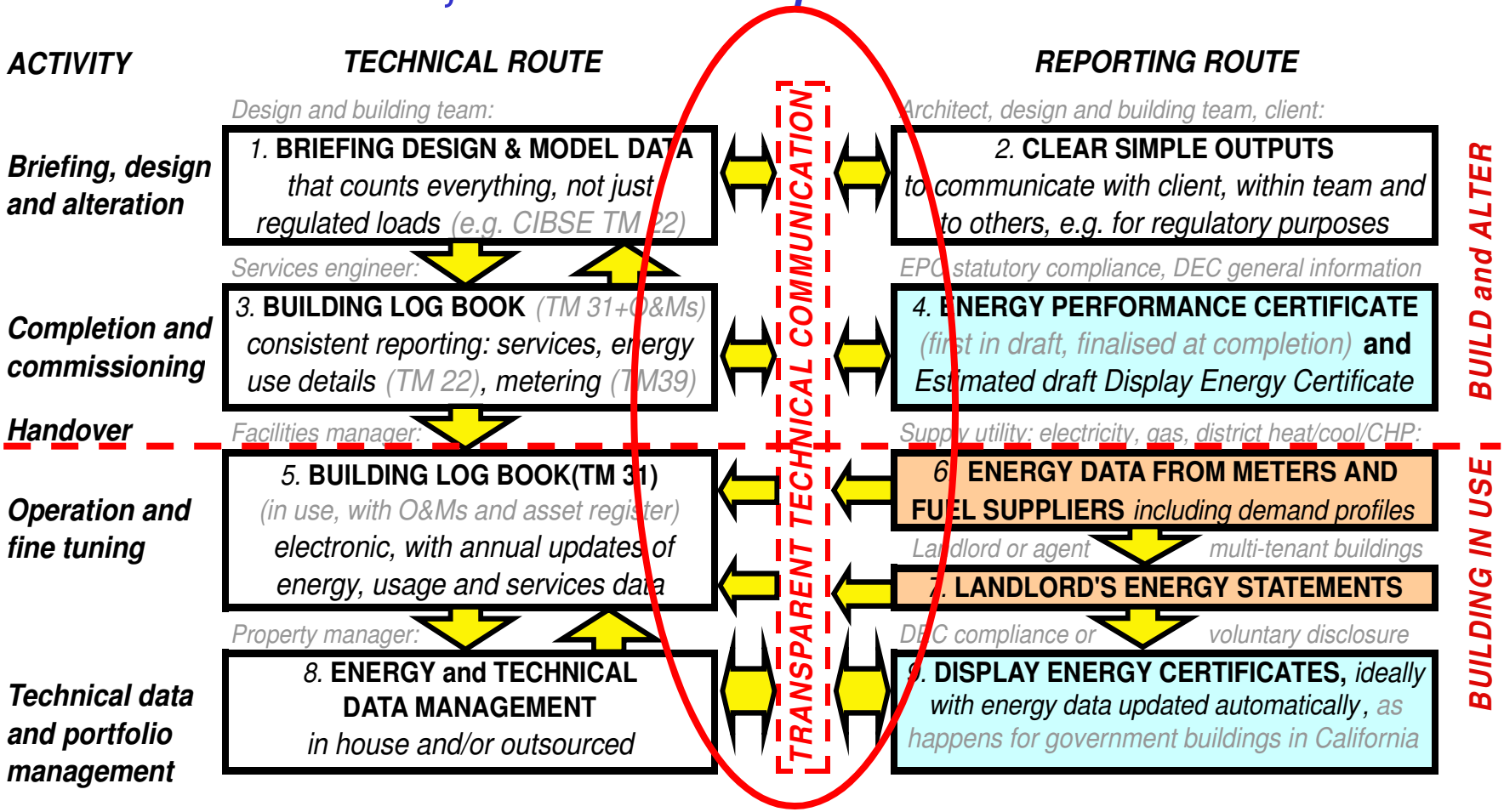
FOR EXAMPLE:

- Between modellers and designers.
- Within design and building teams.
- From designers to clients and other stakeholders.
- From designers and builders to operators.
- Between estimated and actual performance.
- Between buildings, business and policymakers.
- From loads to energy, to CO_2 and other emissions.

and it's been getting worse as more people pile in and buildings get more complicated with renewables etc!

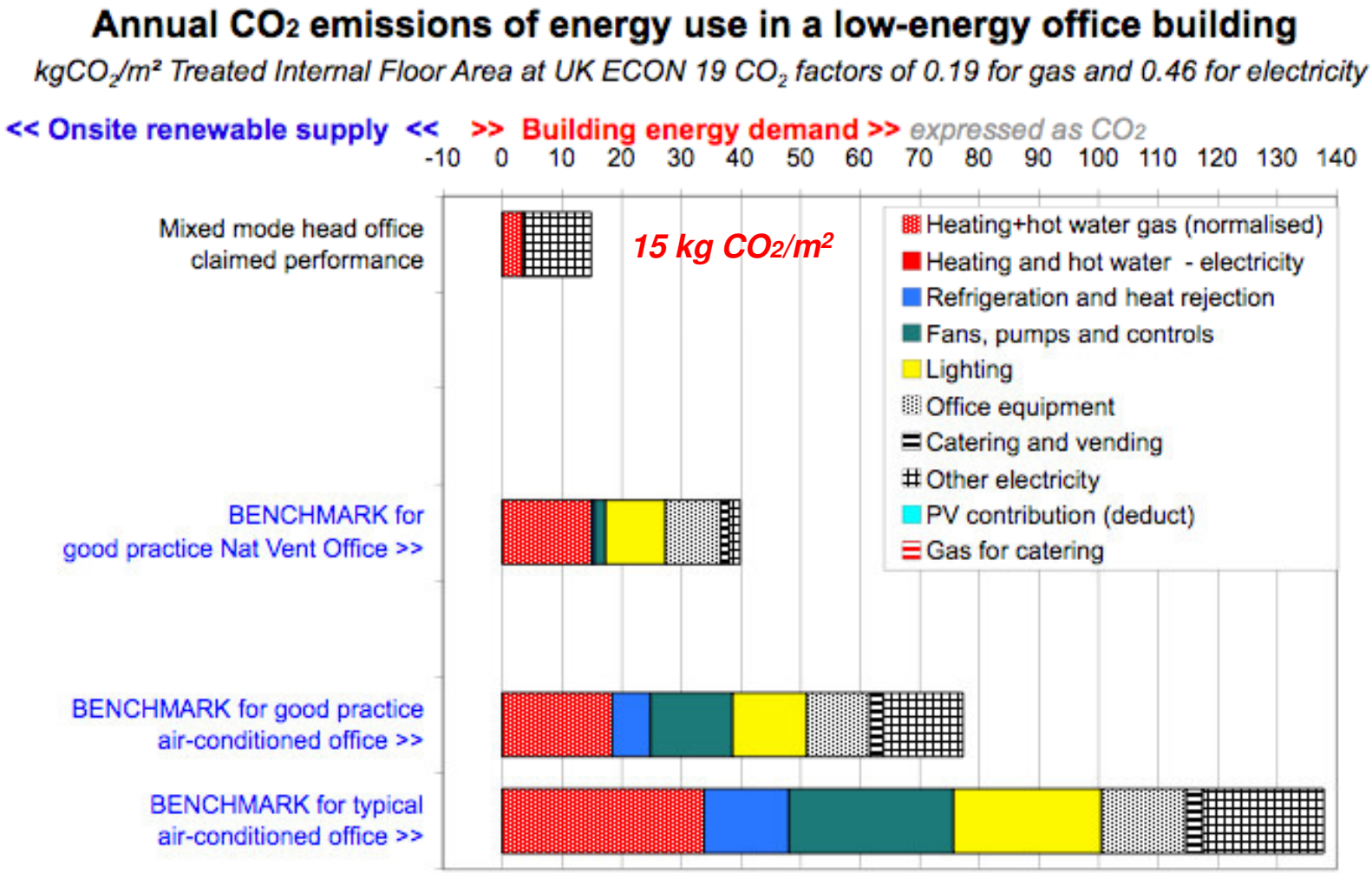
Design intent and building performance need to be communicated much more openly, clearly and consistently.

We need a strong focus on in-use performance, *with transparent communication*

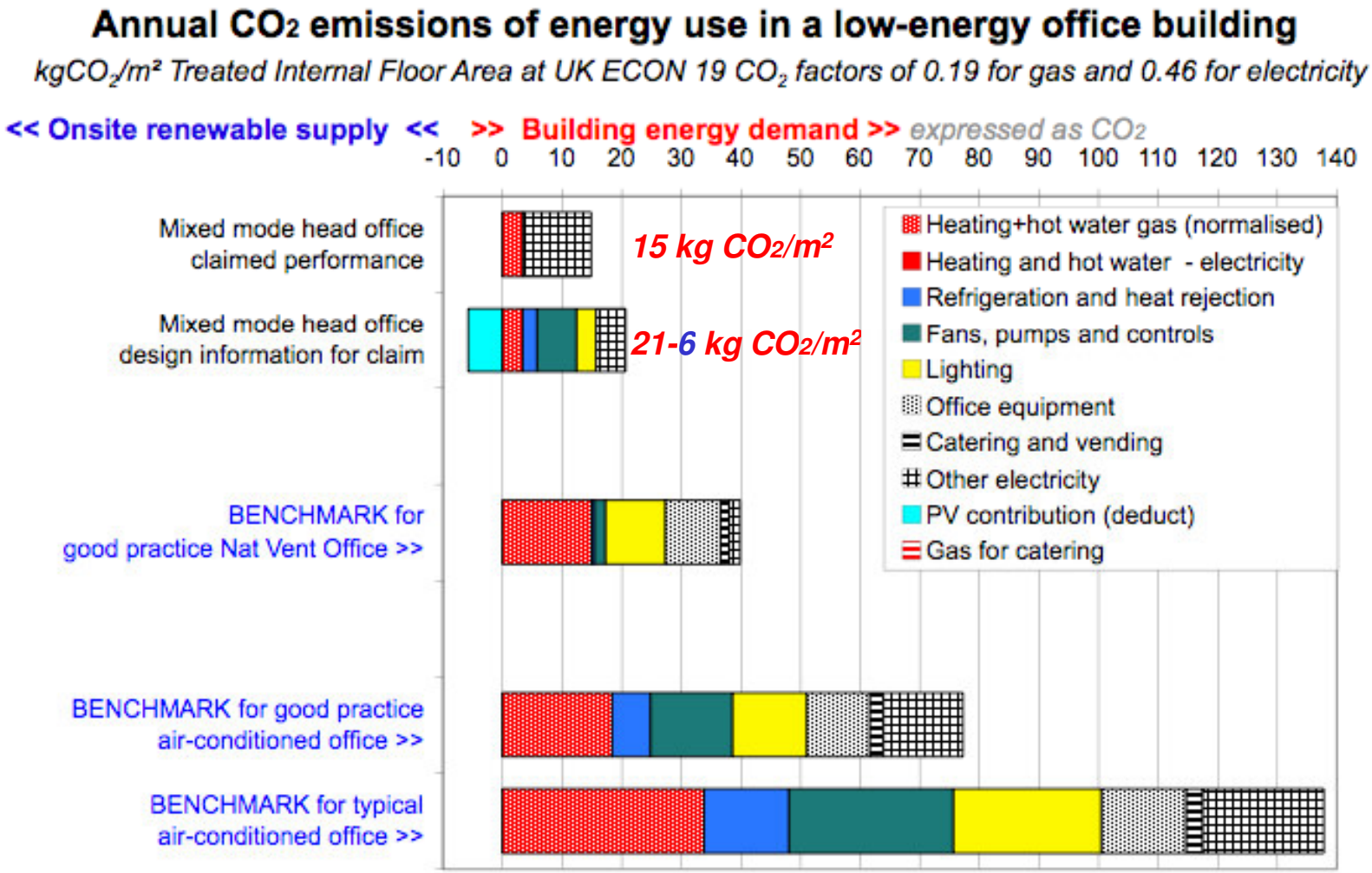


We need proper resources to pull together procedures and provide good quality information and publications.

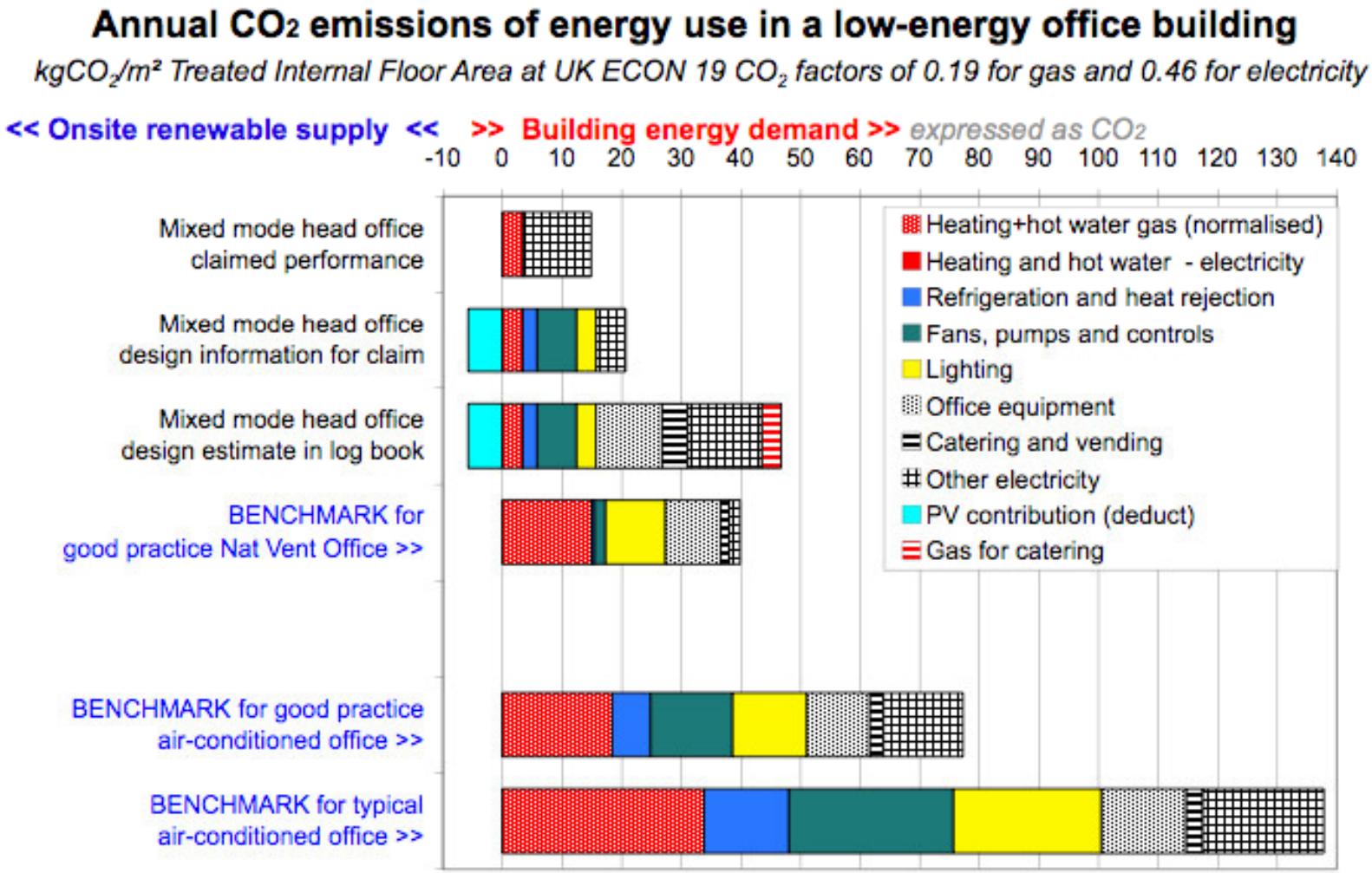
Design intent to reality:
1. the design claim



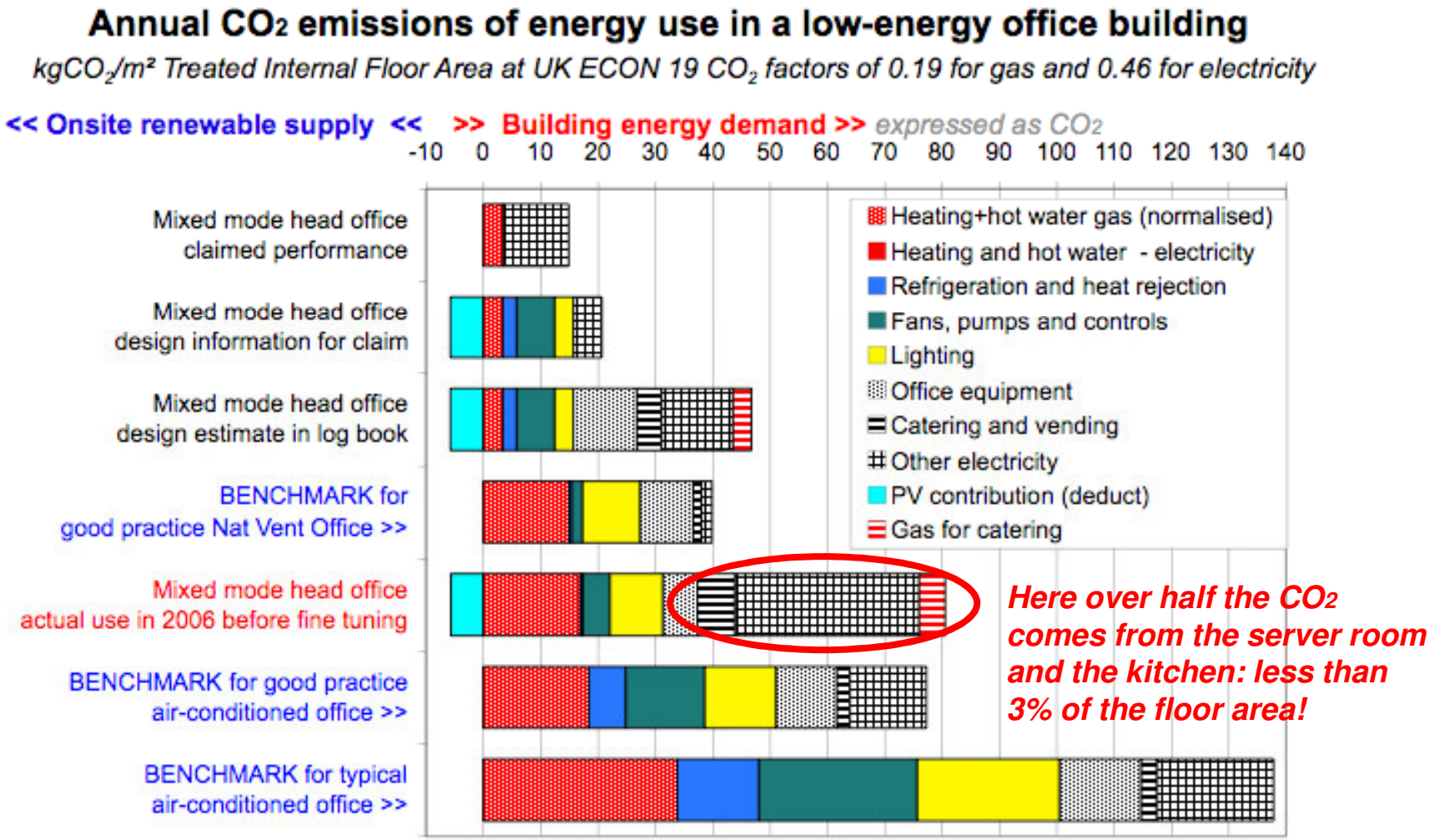
Design intent to reality:
2. supply and demand



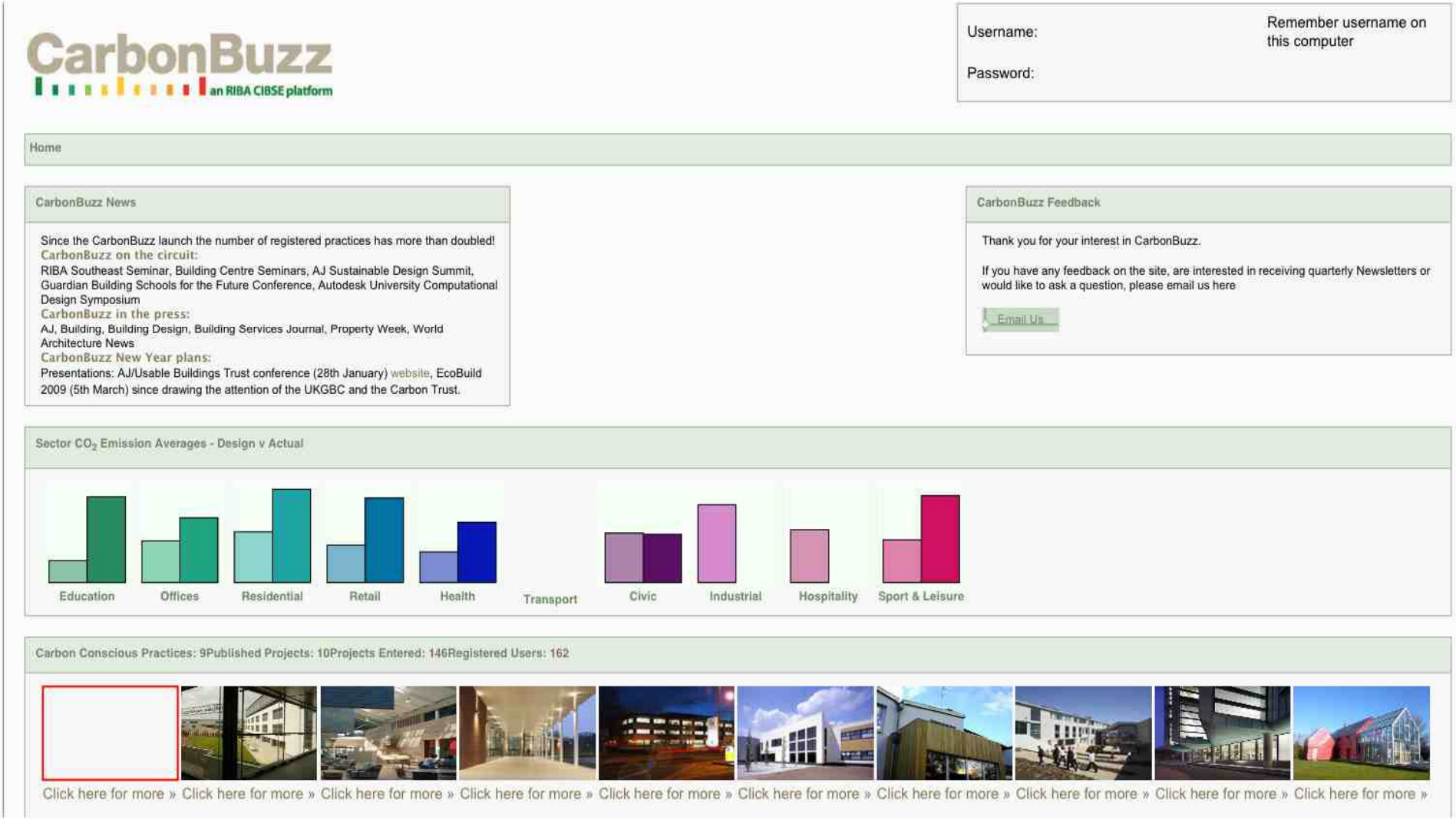
Design intent to reality:
3. What it said in the log book



Design intent to reality:
4. POE results for the first full year



Carbon Buzz is helping to flush this out



An RIBA-CIBSE platform for design and in-use data. Go to www.carbonbuzz.org

This type of graphic can be used to describe breakdowns at any scale

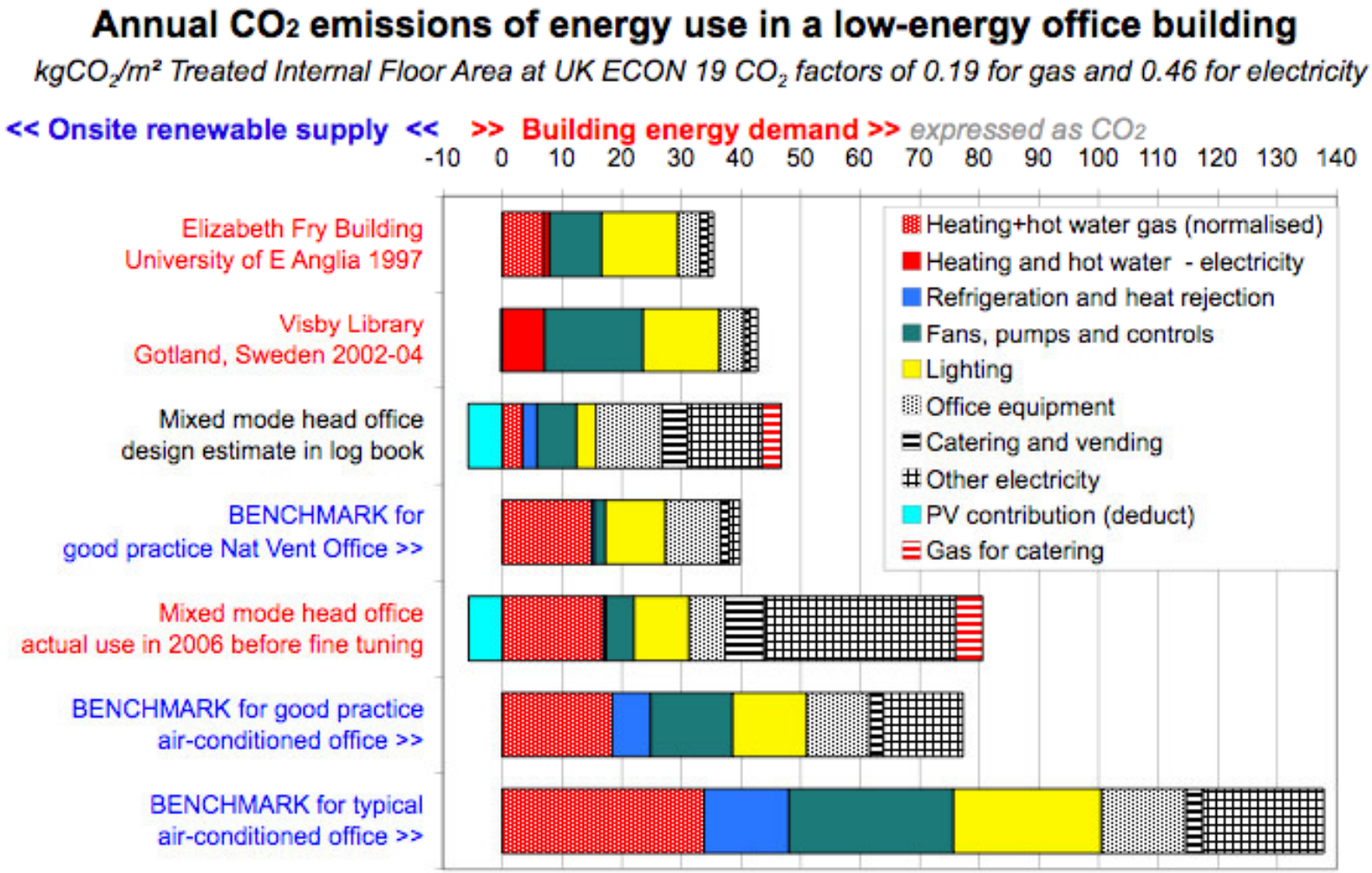
IN SPACE

- Buildings
- Parts of buildings
- Aggregations of buildings *(e.g. campuses, regions, buildings of a particular type, etc..)*
- Split by responsibilities *(e.g. landlords & tenants)*

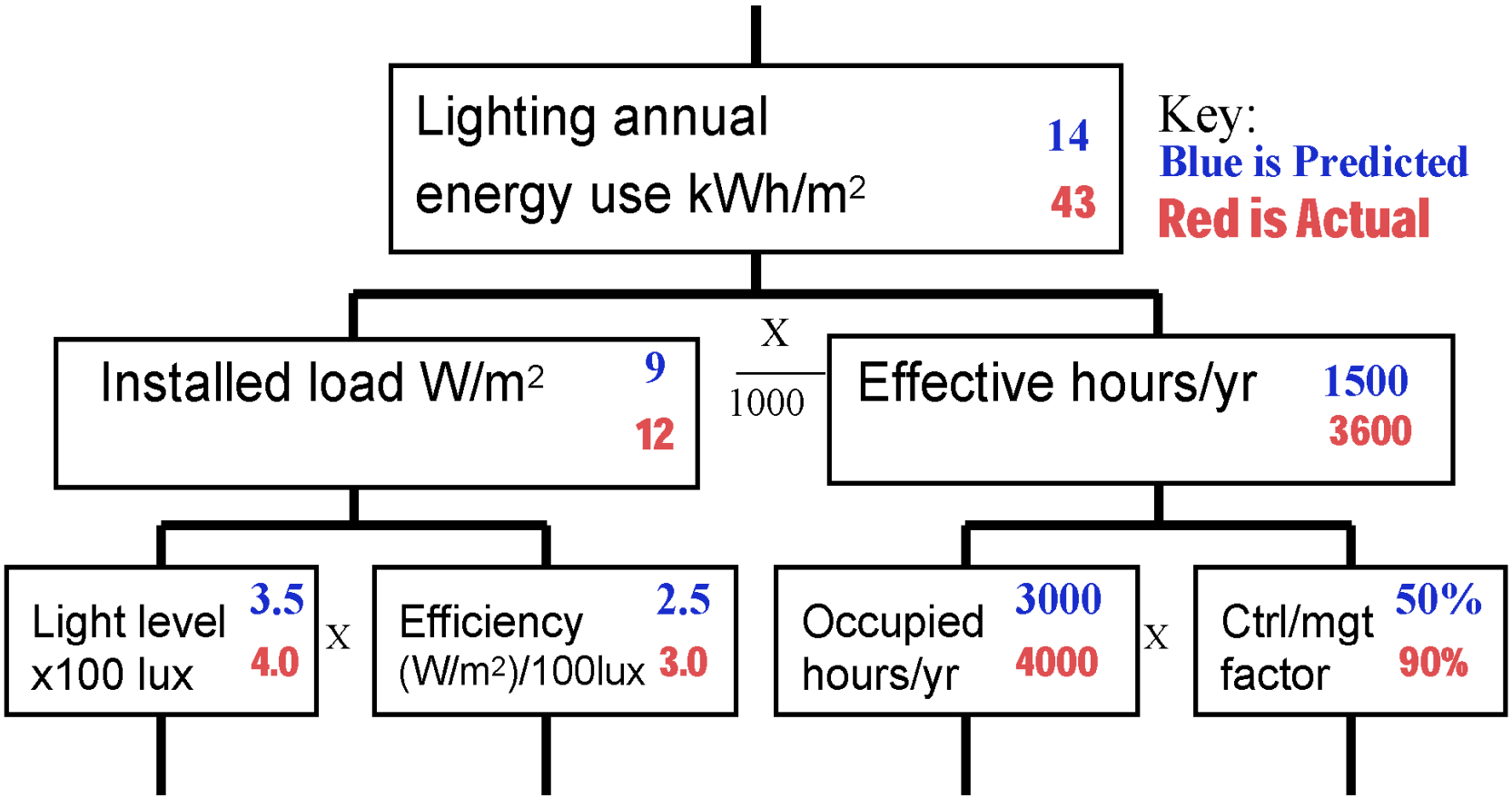
AND IN OTHER DIMENSIONS

- Design intent versus actual performance.
- Performance vs benchmarks and other buildings.
- Performance improvement aspirations.
- Tracking performance over time.

Comparing energy end-use breakdowns
between different buildings and benchmarks



Communicating finer detail: *Actual versus predicted for lighting in a "low-energy" office*



The process is described in CIBSE TM22: *Energy Assessment and Reporting Method,* London: CIBSE (1999 and 2006)

Summary:

Improving practice for better in-use performance

1. Develop communication standards to improve transparency between expectations and outcomes, *so we can prioritise realistically and review results clearly.*
2. Make design intent clear to the users
   especially for controls interfaces of all kinds, manual and automatic.
3. Follow through from design into operation
   talk to people, take account of their perspectives, tune things up, learn from the experience and feed it back.
4. Keep it simple and do it well, *only after that be clever. Design for robustness, usability, manageability.*
   Prevention is better than cure *… and*
5. Watch out for unintended consequences and revenge effects: "*good enough" is often better than "just right".*
6. Building simulation needs to take a rather different role,
   with much better communication, constant reality-checking, and more awareness of what really happens once buildings are in use.


We need to save real energy and carbon
not virtual energy and carbon!
NATURE CAN'T BE FOOLED … Richard Feynman
www.usablebuildings.co.uk