CIBSE NATIONAL CONFERENCE, British Museum
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Managing expectations for energy and carbon performance

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Structure of the talk

1. THE CREDIBILITY GAPS:
   Why do so many new buildings use much more energy than their designers and modellers predict?

2. MAKING PERFORMANCE VISIBLE AND ACTIONABLE
   Making better use of energy certificates, and going beyond

3. COMMUNICATING ENERGY PERFORMANCE and MANAGING EXPECTATIONS
   Supporting better decisions - a task for CIBSE?

1

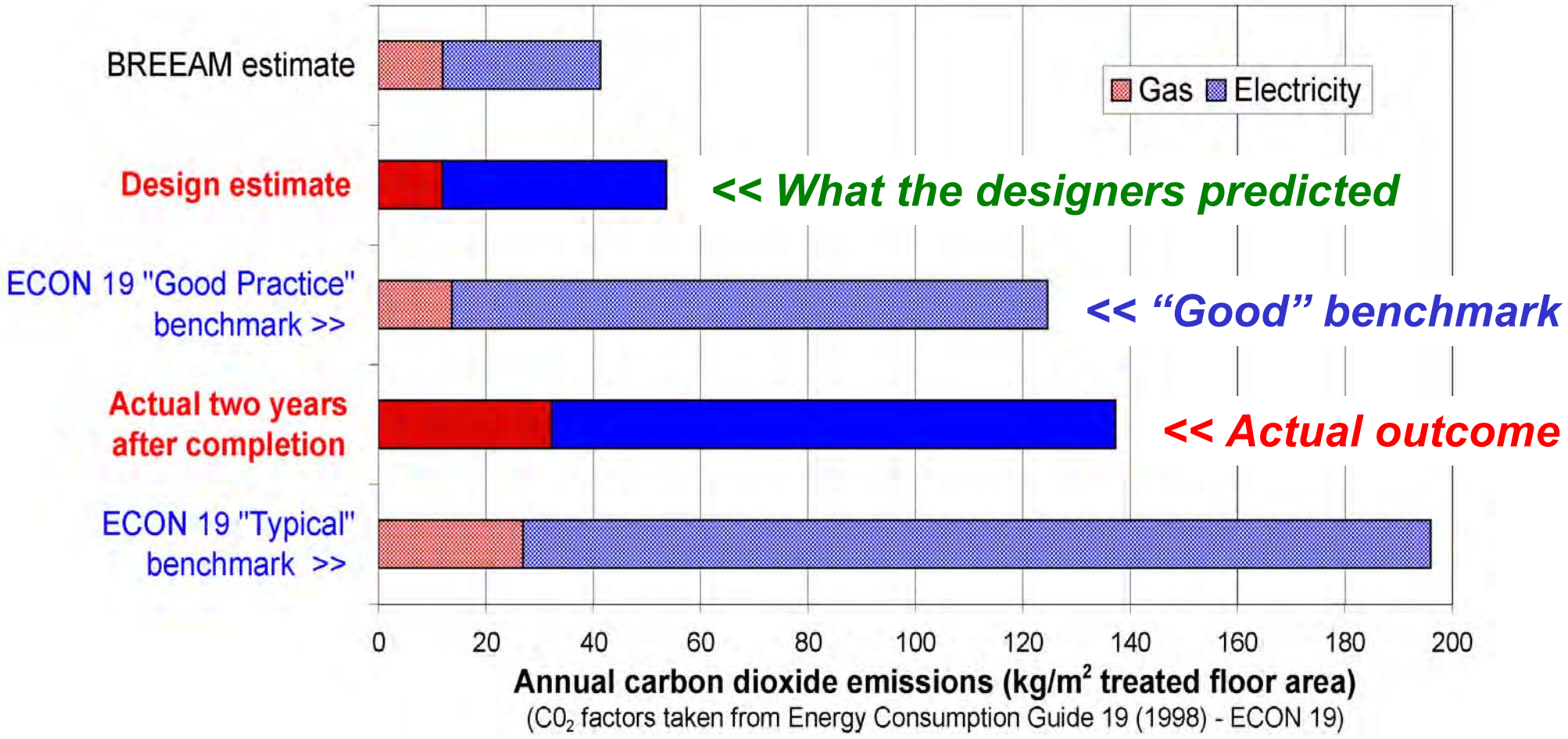
DESIGN EXPECTATION AND REALITY: *THE CREDIBILITY GAPS*

The Credibility Gap: *We couldn't deliver low-energy and carbon performance reliably in the 1990s. We're still finding it difficult.*


Green office increases energy use

BUILDING DESIGN 26 NOV 04

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



SOURCE: data from S Curwell et al, *The Green Building Challenge in the UK,* Building Research & Information **27** (4/5) 286 (1999).

What do we tend to find *when we review performance of recent buildings?*

- They often perform much less well than anticipated, *especially for energy (notably electricity) use, carbon, and occupant satisfaction.*
- Unmanageable complication is the enemy of good performance. *So why are we making buildings more complicated and difficult to manage in the name of sustainability? Prevention is better than cure.*
- Design intent is seldom communicated well to users and managers. *Designers and builders tend to go away at handover.*
- Buildings are seldom tuned-up properly, and controls are a mess. *So now we have more things to do, what chance do we have?*
- Good environmental performance + occupant satisfaction can go hand in hand, *but only where good, committed people have made it happen.*
- Modern procurement systems can make it difficult to do things properly, with enough attention to detail. *Need a new professionalism that engages routinely with outcomes, e.g. using* ***Soft Landings****.*

KEEP IT SIMPLE, DO IT WELL,
FOLLOW IT THROUGH, TUNE IT UP

Controls, manageability and usability need much more attention at all stages

"An intelligent building is one that doesn't make its occupants feel stupid"… ADRIAN LEAMAN

"We sell dreams and install nightmares"… BMS SUPPLIER

Design intent to reality:
how the credibility gaps can open up

DESIGN ESTIMATES NOT SET CLEARLY OR REALISTICALLY:

- Little or no transparency between design estimates and in-use outcomes.
- Not everything is counted: *only normal "regulated" services in typical spaces.*
- Estimates are too optimistic, e.g. *no night loads, perfect control.*
- A policy concentration on carbon draws a veil over energy performance.

SLIPPAGE DURING DESIGN AND CONSTRUCTION:

- Design does not get into areas of critical detail, or understand the users.
- Changes to design and client requirements, *vandal "Value Engineering".*
- Changes during construction and commissioning: *negotiations, substitutions, build quality, systems, deployment of controls, delays.*

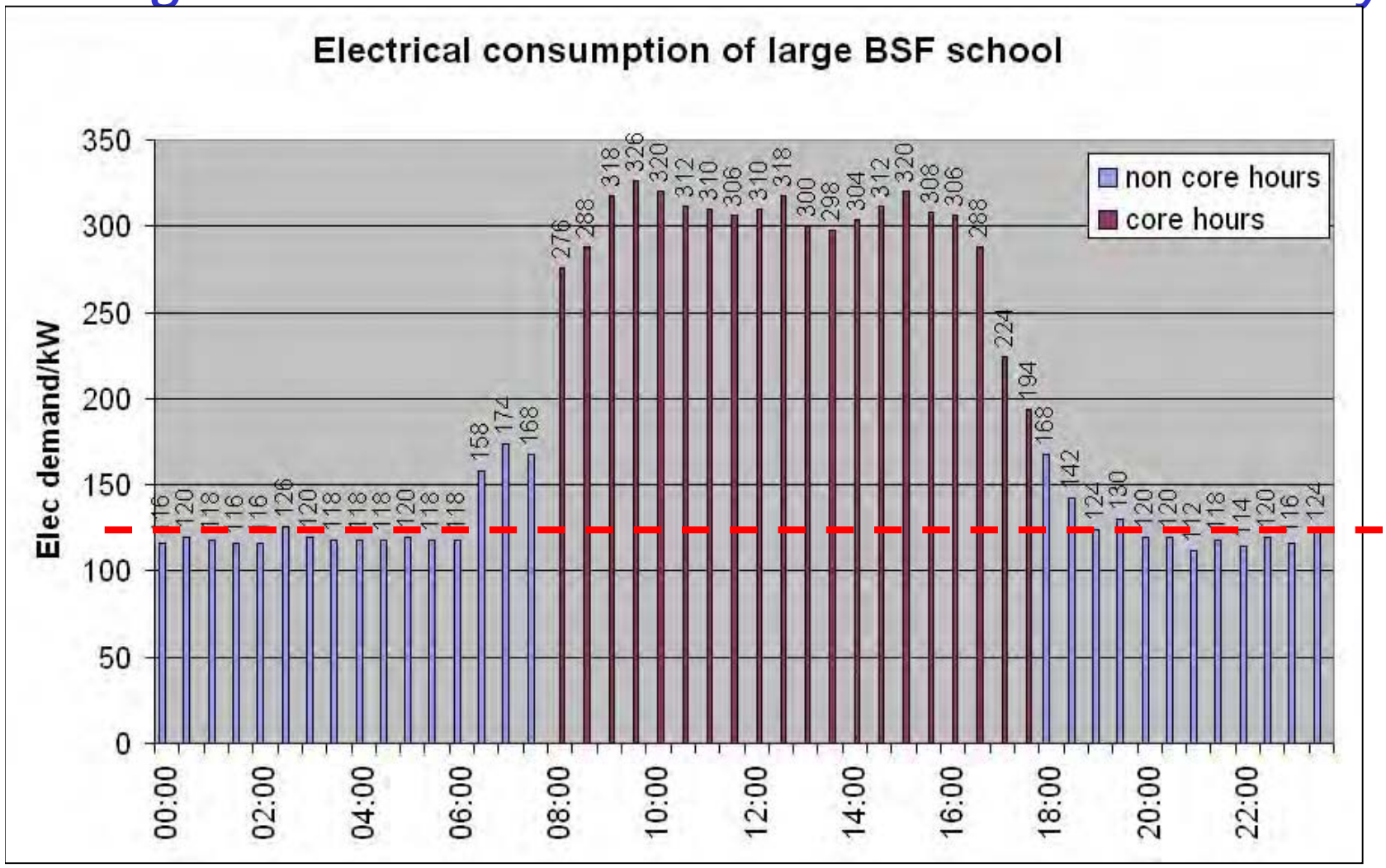
SLIPPAGE AFTER COMPLETION:

- No follow-through, initial aftercare, fine-tuning, monitoring, or feedback.
- Fitout changes and clashes.
- Spilt responsibilities: *developer/owner, landlord/manager/tenant, outsourcing. Principal/agent problems. Procurement of controls and FM services.*
- Unintended consequences and revenge effects, *technical and management shortcomings, controls problems, poor user interfaces, default to ON.*

DESIGN INTENT NOT MANAGED THROUGH THE PROCESS AND INTO USE

An important priority: Avoid default to ON

e.g. kWh/half hour in a recent UK 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% (~ $ 125 k) of electricity used at other times: 14% term weekends, 26% term nights, 16% holidays

SOURCE: With thanks to monitoring work by Buro Happold (October 2009)

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MAKING ENERGY AND CARBON PERFORMANCE VISIBLE AND ACTIONABLE

Making performance visible:
What's it all for?

- A spur to effective action, *not just for designs, but especially in use for both new and older buildings.*
- Achieve rapid early reductions in fossil fuel use *(it is the cumulative emissions that count)* and peak loads.
  We need to save real, not virtual carbon.
- Close the feedback loop so we know what really works.
- Build momentum to a decarbonised economy; **AND**

- ***Motivate ALL the players concerned.***
- *Seize the opportunity points, and focus on what works.*
- *Exploit synergies and multiplier effects to get big benefits*
- *Minimise bureaucracy and transaction costs.*
- *Seek to avoid unintended consequences, and spending scarce resources on doing the wrong things;* ***and so …***
- ***we need consistent technical underpinnings.***

Making performance visible: *Sub-metering is mandated, but is it commissioned and used?*

This high voltage utility meter was wrongly calibrated, leading to substantial overcharging. This is rare, but not unique.

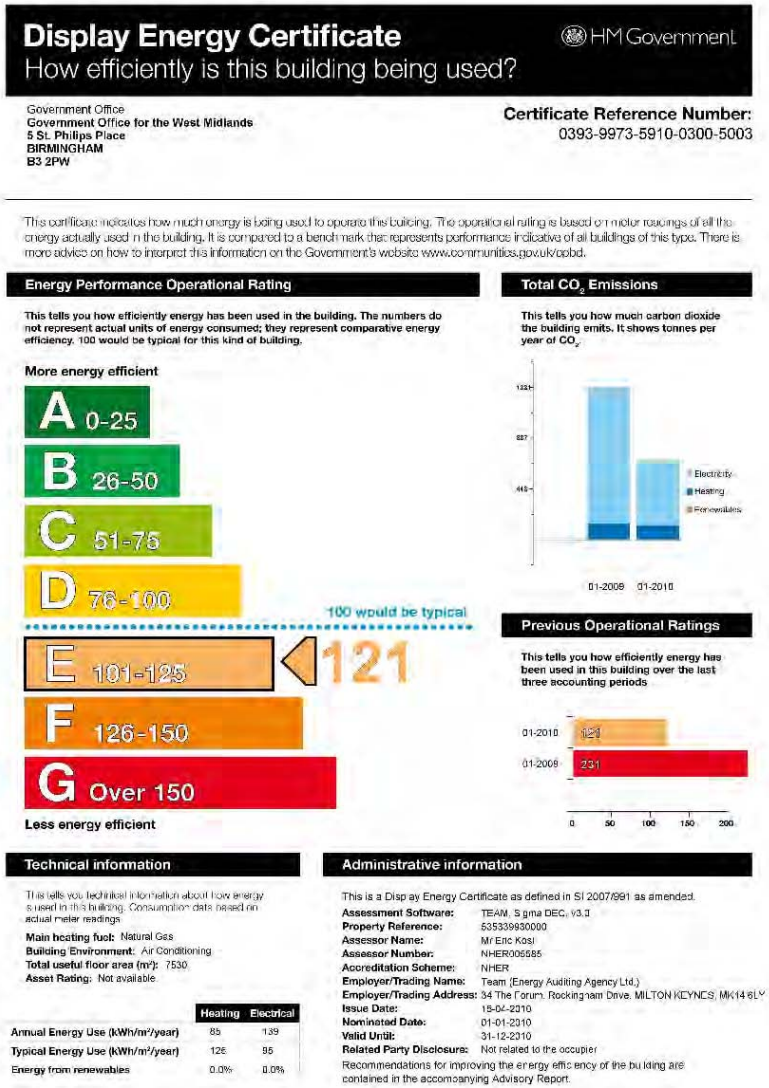
The principal sub-meter did not work, so the utility meter fault went five years undetected. The other sub-meters were wrongly calibrated, so cross checks were impossible.

Making performance visible

Display Energy Certificates (DECs) in England+Wales

Ambitions of Europrosper research project 2002-04:

- Display Energy Certificates based on actual energy use, not just theoretical.
  Achieved, with CO_2 headline.
- Transparency between expectations and outcomes.
  Incomplete
- Multiple performance indicators
  There, but little on display
- Commercial buildings: **not yet**
- **We need supplementary voluntary reporting measures**



Display Energy Certificate
How efficiently is this building being used?

HM Government

Government Office
Government Office for the West Midlands
5 St. Philips Place
BIRMINGHAM
B3 2PW

Certificate Reference Number:
0393-9973-5910-0300-5003

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.

More energy efficient

A 0-25
B 26-50
C 51-75
D 76-100
100 would be typical
E 101-125 121
F 126-150
G Over 150

Less energy efficient

Total CO_2 Emissions

This tells you how much carbon dioxide the building emits. It shows tonnes per year of CO_2

Electricity
Heating
Renewables

01-2009 01-2010

Previous Operational Ratings

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

01-2010 121
01-2009 231

0 50 100 150 200

Technical information

This tells you technical information about how energy is used in this building. Consumption data based on actual meter readings

Main heating fuel: Natural Gas
Building Environment: Air Conditioning
Total useful floor area (m^2): 7530
Asset Rating: Not available

	Heating	Electrical
Annual Energy Use (kWh/m^2/year)	85	139
Typical Energy Use (kWh/m^2/year)	126	95
Energy from renewables	0.0%	0.0%

Administrative information

This is a Display Energy Certificate as defined in SI 2007/991 as amended.

Assessment Software: TEAM, Sigma DEC, v3.0
Property Reference: 535339930000
Assessor Name: Mr Eric Kosi
Assessor Number: NHER005585
Accreditation Scheme: NHER
Employer/Trading Name: Team (Energy Auditing Agency Ltd.)
Employer/Trading Address: 34 The Forum, Rockingham Drive, MILTON KEYNES, MK14 6LY
Issue Date: 15-04-2010
Nominated Date: 01-01-2010
Valid Until: 31-12-2010
Related Party Disclosure: Not related to the occupier

Recommendations for improving the energy efficiency of the building are contained in the accompanying Advisory Report.

For more detail on Europrosper and its successor EPLabel, go to www.europrosper.org and www.eplabel.org

Unintended consequences of energy certification already becoming evident

- **Certificates seen as an end in themselves**, instead of a window onto a wider world of building performance and a platform for understanding and improvement.
- **Clumsy processes** with unnecessarily high transaction costs in relation to the value added.
- **Poor connections** with other aspects of energy policy, e.g. smart metering, Carbon Reduction Commitment, incentives.
- **Data exchange hobbled** by probably needless fears about confidentiality - *fortunately this seems to be beginning to change.*
- **Gravy train** for certification, accreditation and training agencies, whose business case is related to the transaction, not the outcome.
- **Little appreciation** of the realities of rented and multi-tenanted buildings, with multiple players and outsourced services.
- **The CO_2 metric tends to drive the outcome:** so a need for clearer multiple metrics, *e.g. electrical, thermal, primary energy, separation between supply and demand; and identification of unusual features.*

Energy certificates alone are not enough

Strategy proposed to CIBSE for UK system in 2007

1. BENCHMARKS FOR DECs

- Simplified starter benchmarks.
- Thermal and electrical values, then converted to CO_2.
- Severe: assume low intensity of use and standard services.
- Optional corrections allowable for *specials* and high intensity use, *if rigorously verified.*
- Will evolve in the future.

2. VOLUNTARY BENCHMARKING

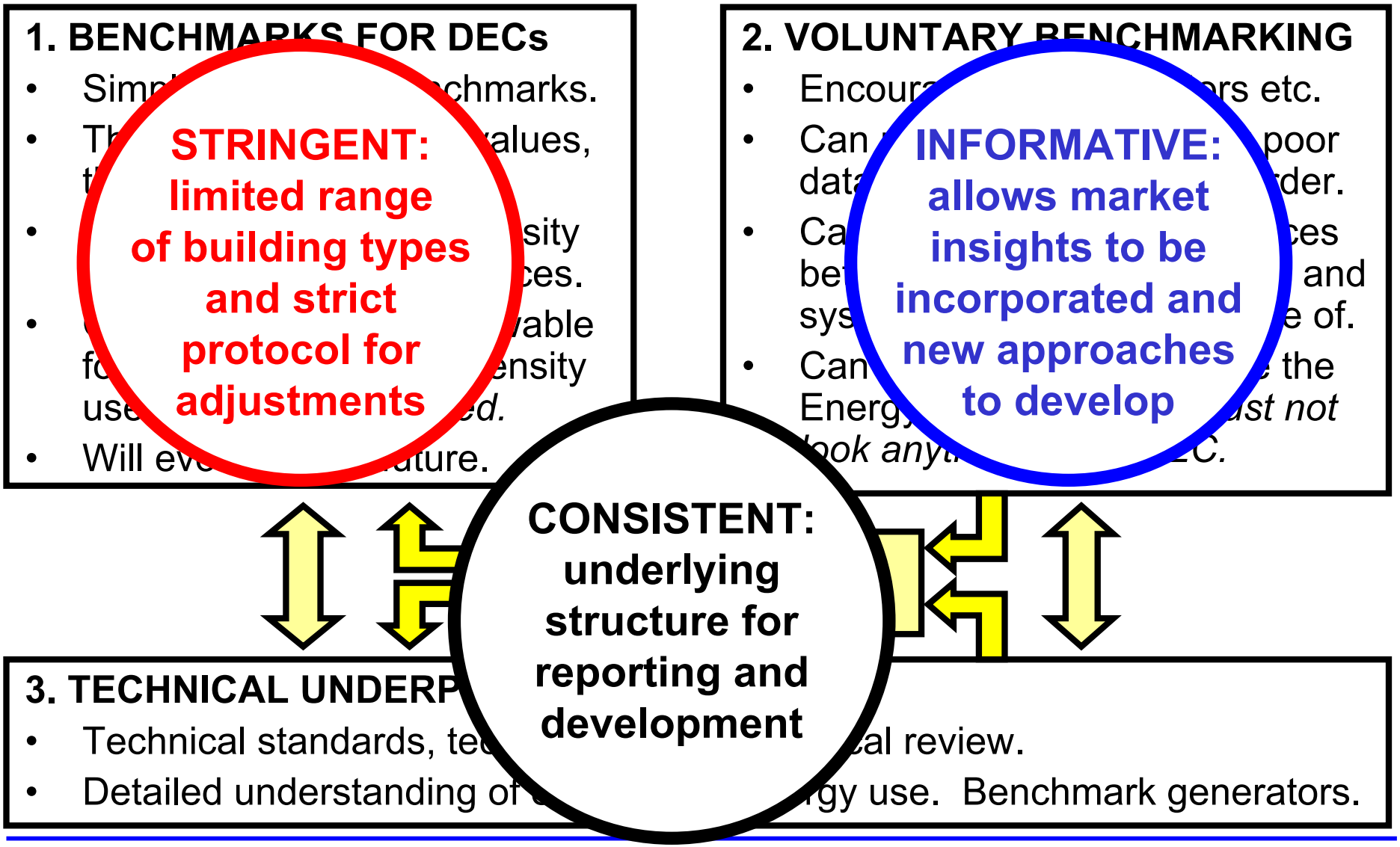
- Encouraged within sectors etc.
- Can make use of relatively poor data, e.g. sorted into rank order.
- Can take account of differences between building types, uses and systems the industry is aware of.
- Can be displayed alongside the Energy Certificate, *but must not look anything like a DEC.*

3. TECHNICAL UNDERPINNINGS

- Technical standards, technical details, technical review.
- Detailed understanding of elements of energy use. Benchmark generators.

Complementary benchmarking routes

Strategy proposed to CIBSE for UK system in 2007



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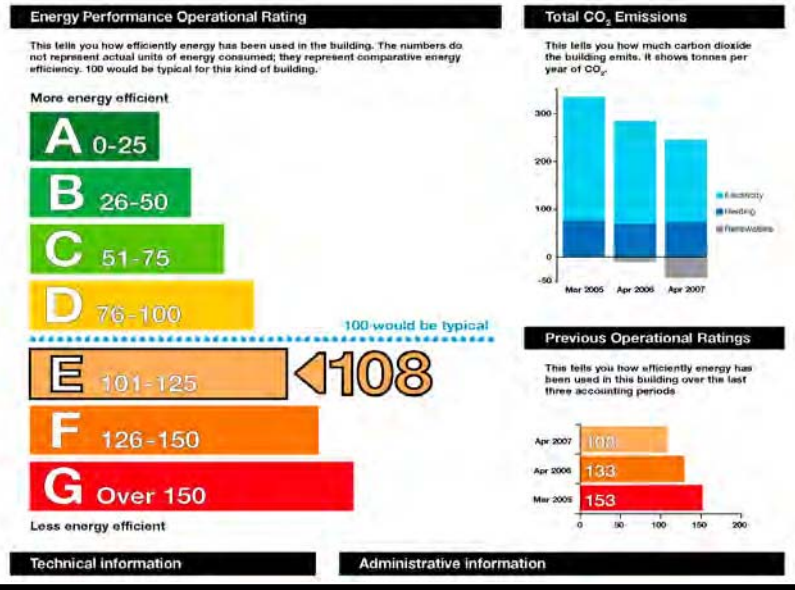
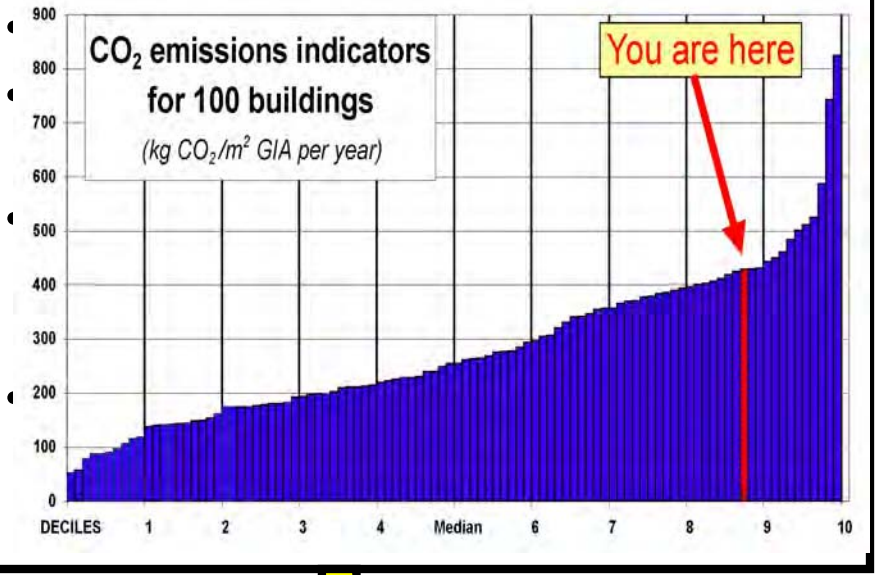
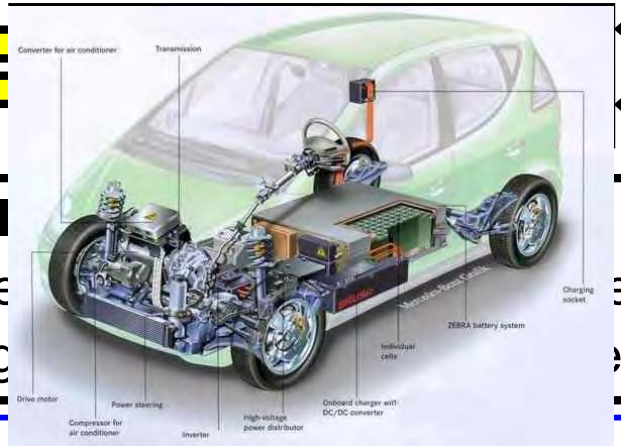


2. VOLUNTARY BENCHMARKING





3. TECHNICAL UNDERPI

- Technical standards, te eview.
- Detailed understanding e. Benchmark generators.

3

COMMUNICATING ENERGY and CARBON PERFORMANCE AND MANAGING EXPECTATIONS

Getting under the bonnet

Communicating energy performance:

Houston, we have a problem …

WE'RE NOT COMMUNICATING CLEARLY ENOUGH:

- 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:

A task for CIBSE …

Pulling everything together: a universal framework can get complicated

- **Components** that use energy, e.g. lights, PCs etc..
- **Systems** supplying the components, e.g. lighting circuits.
- and/ or **Rooms or areas** with all their systems and uses.
- **Plant** that supplies the systems, e.g. air handling units.

THESE ALL ADD UP TO THE TOTAL BUILDING LOADS

Picking up inefficiencies as they go, until they reach

- **Central energy conversion plant,** e.g. boilers, chillers.

WHICH ACCOUNTS FOR THE BUILDING ENERGY USE

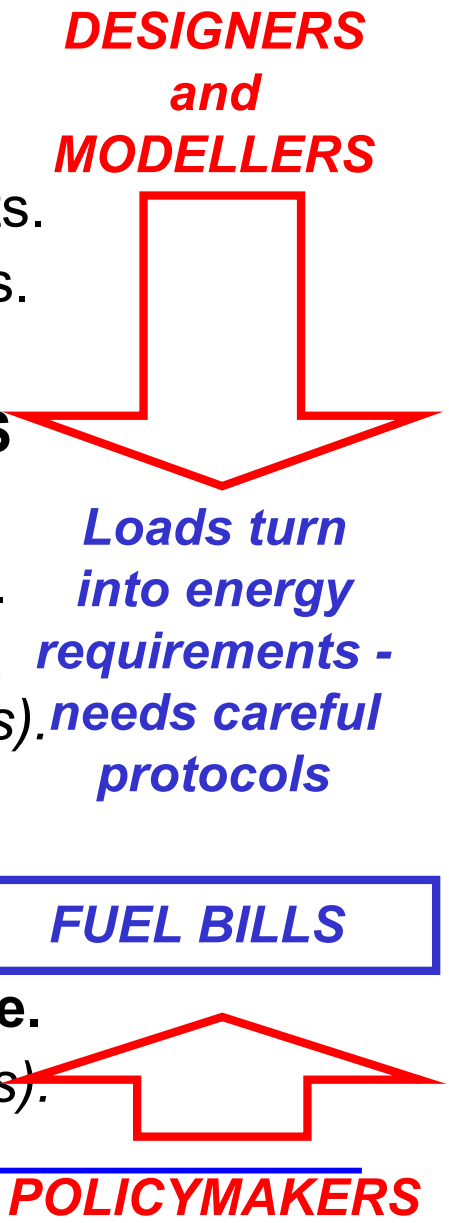
may also include special items(e.g. outdoors, processes).

- Then account for **on-site renewable** energy supplies *(CEN conventions put these external to the building).*

SO AT LAST YOU KNOW THE PURCHASED ENERGY

- **But then you must account for what happens off site.**

(for which there is seldom a unique set of carbon factors).



Making performance details more visible:
communicating the complicated simply and clearly

REPORT AND BENCHMARK AT VARIOUS LEVELS:

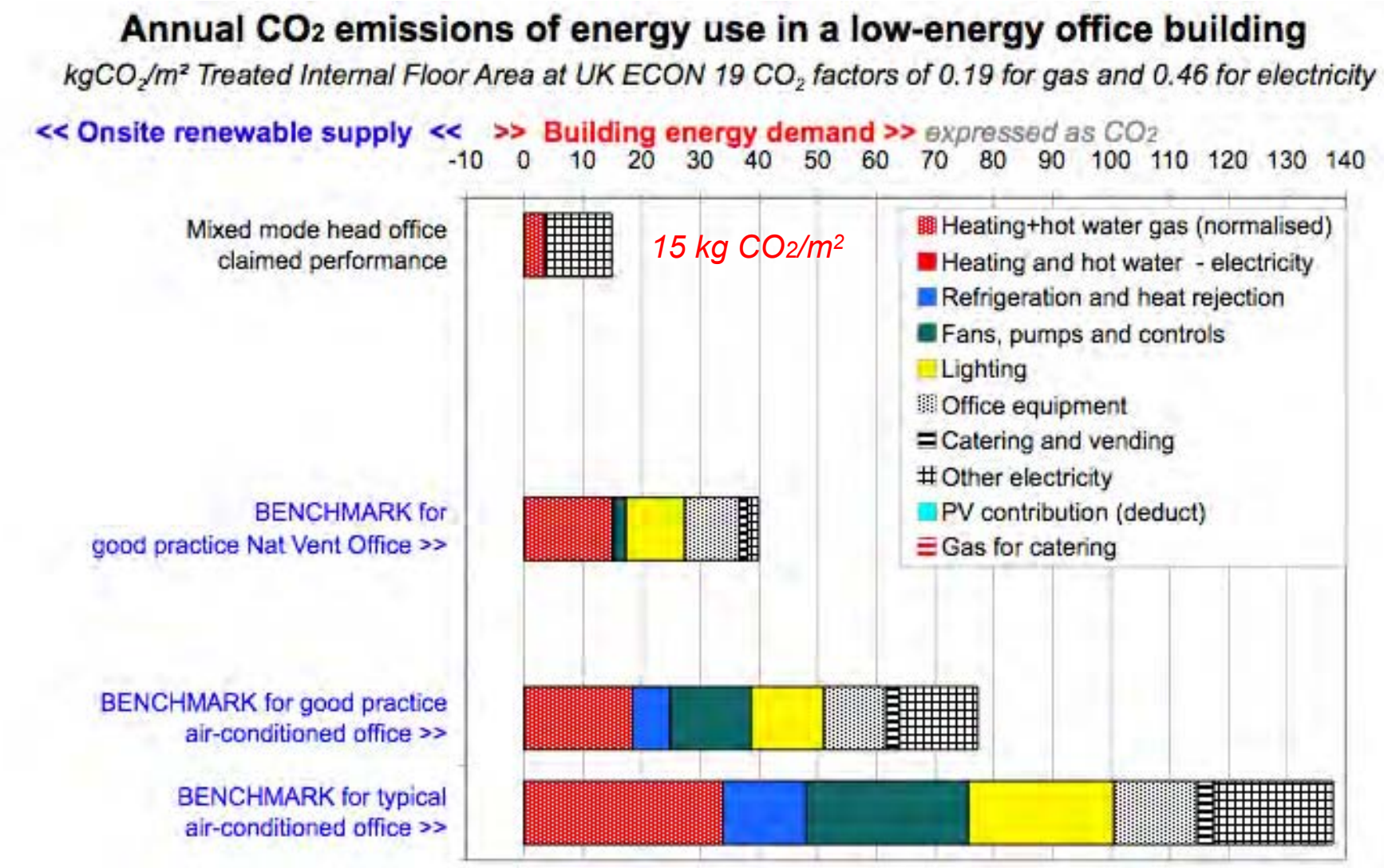
- **Whole premises** *(e.g. buildings, groups)* - multiple performance indicators.
- **Systems and end-uses** - use familiar graphic and tabular conventions.
- **Components** - review key numbers *(e.g. W/m^2).*
- **Energy demand profiles** *(e.g. half-hourly)* and related performance indicators.
- Start simple, but allow drill-down to progressively increasing levels of detail.

DEVELOP CONSISTENT WINDOWS ONTO PERFORMANCE:

- Agree standard approaches and reporting formats (graphic and numeric) with which people can become familiar, so they can concentrate on the data.
- Maximise transparency between intentions and outcomes.
- Base the approach on engineering values - apply policy weightings etc. (e.g. carbon factors) reversibly, at the last responsible moment.
- Make assumptions clear, and include opportunities for “what if” calculations.
- Incorporate the core in reporting devices to suit a wide range of stakeholders.

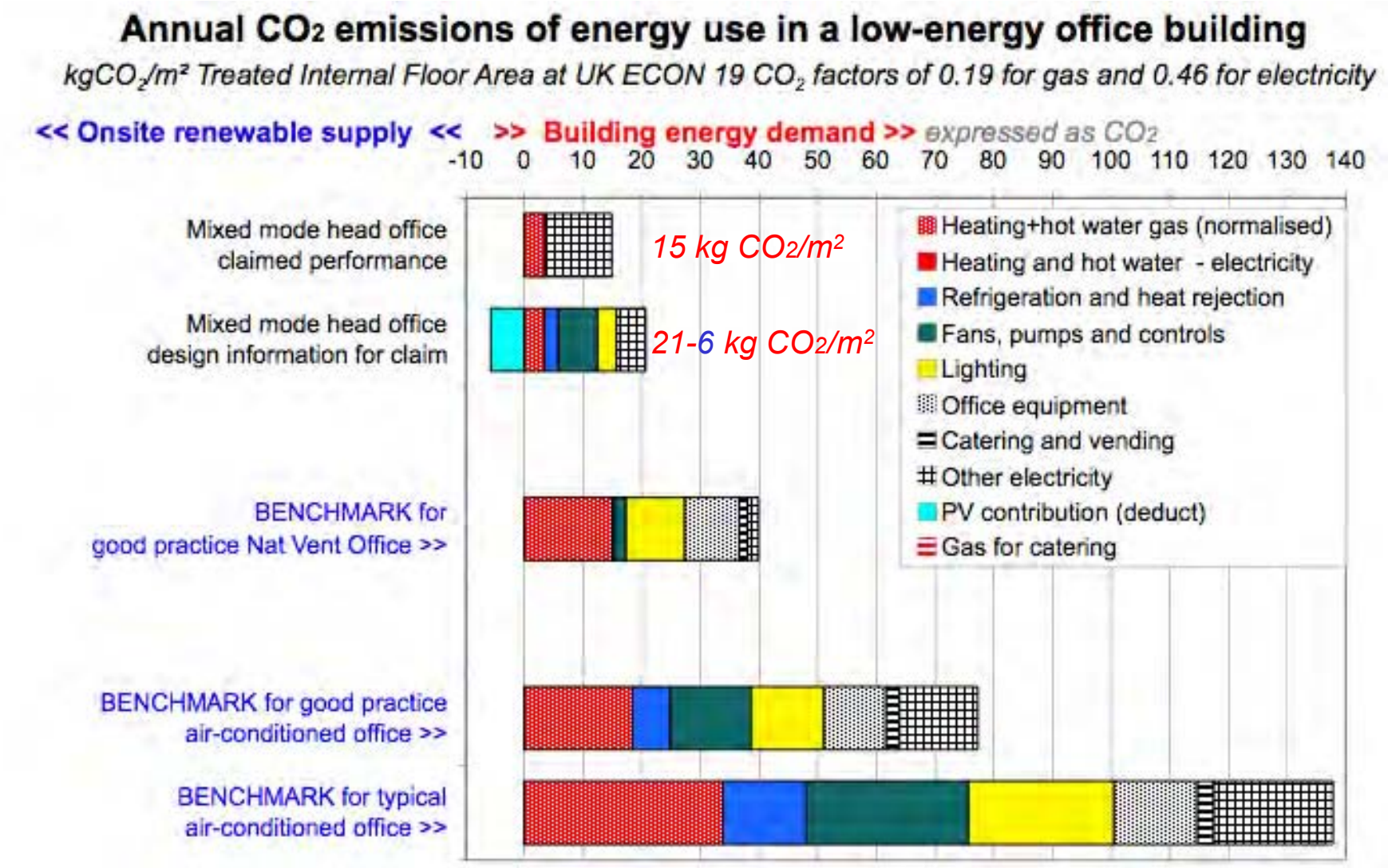
An example for end uses at building level

1: the design claim, as published



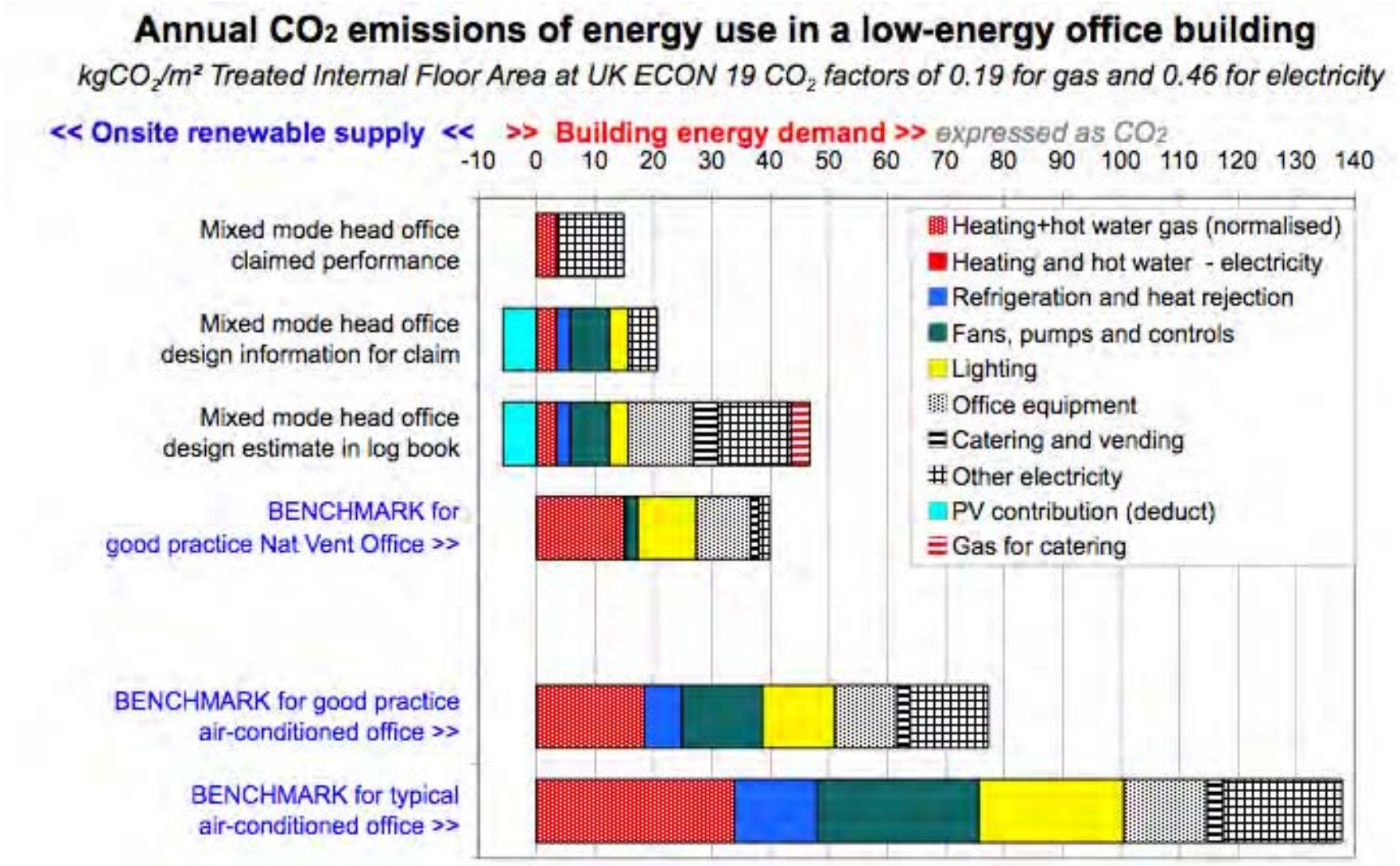
Expectations Management: an example

2: the basis for the design claim



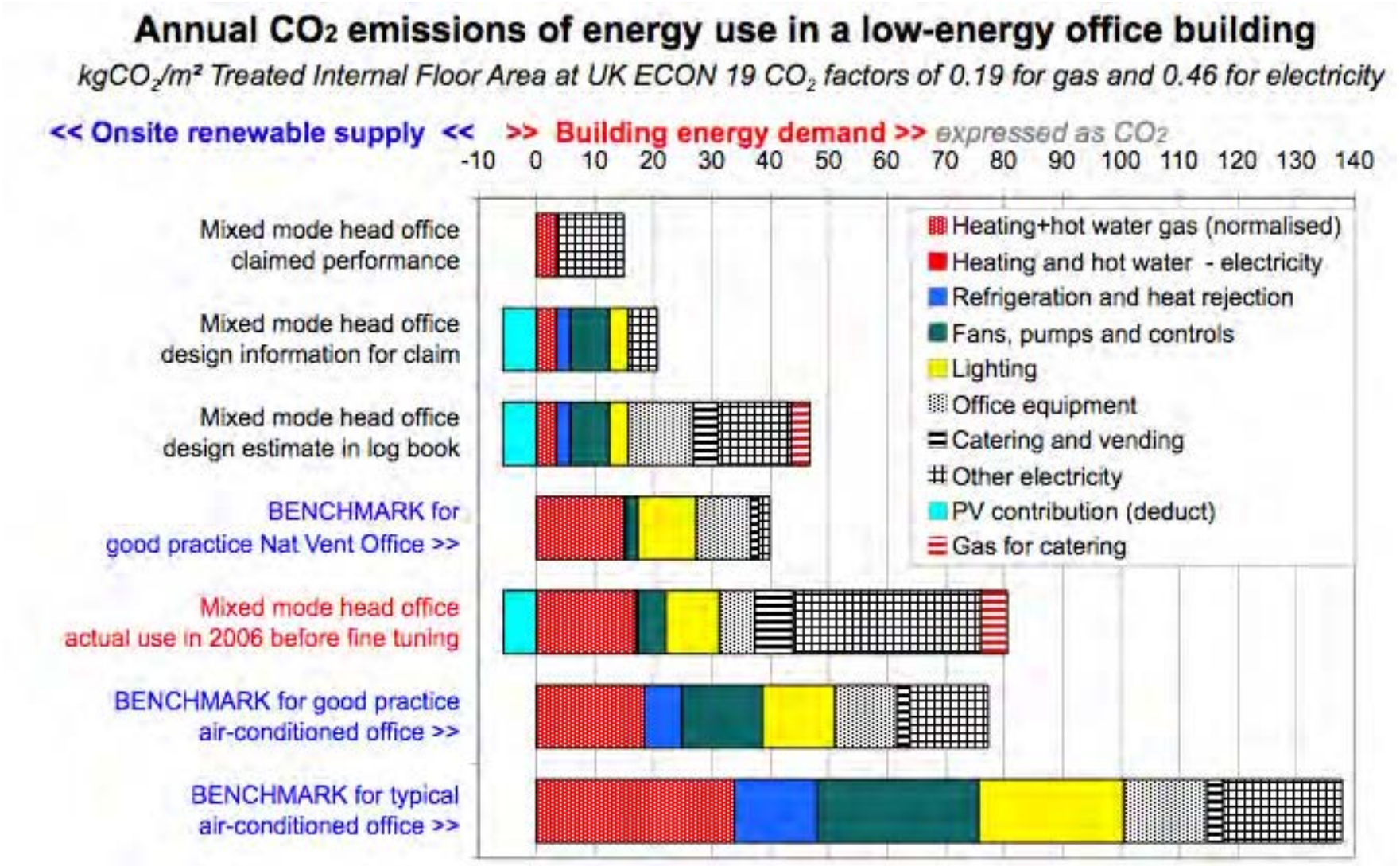
Expectations Management: an example

3: what it said in the log book supplied at handover



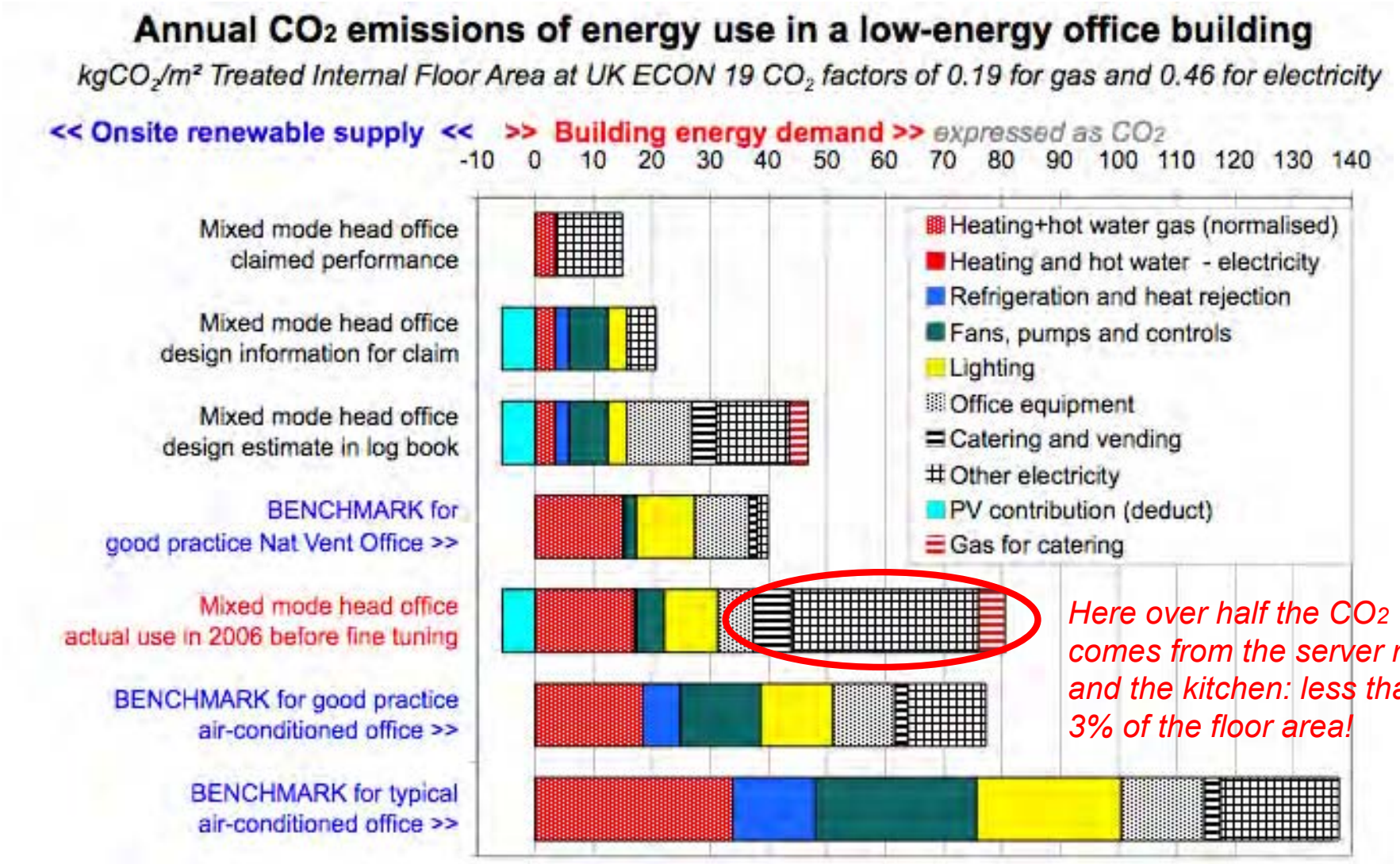
Expectations Management: an example

4: actual performance in use, before fine tuning



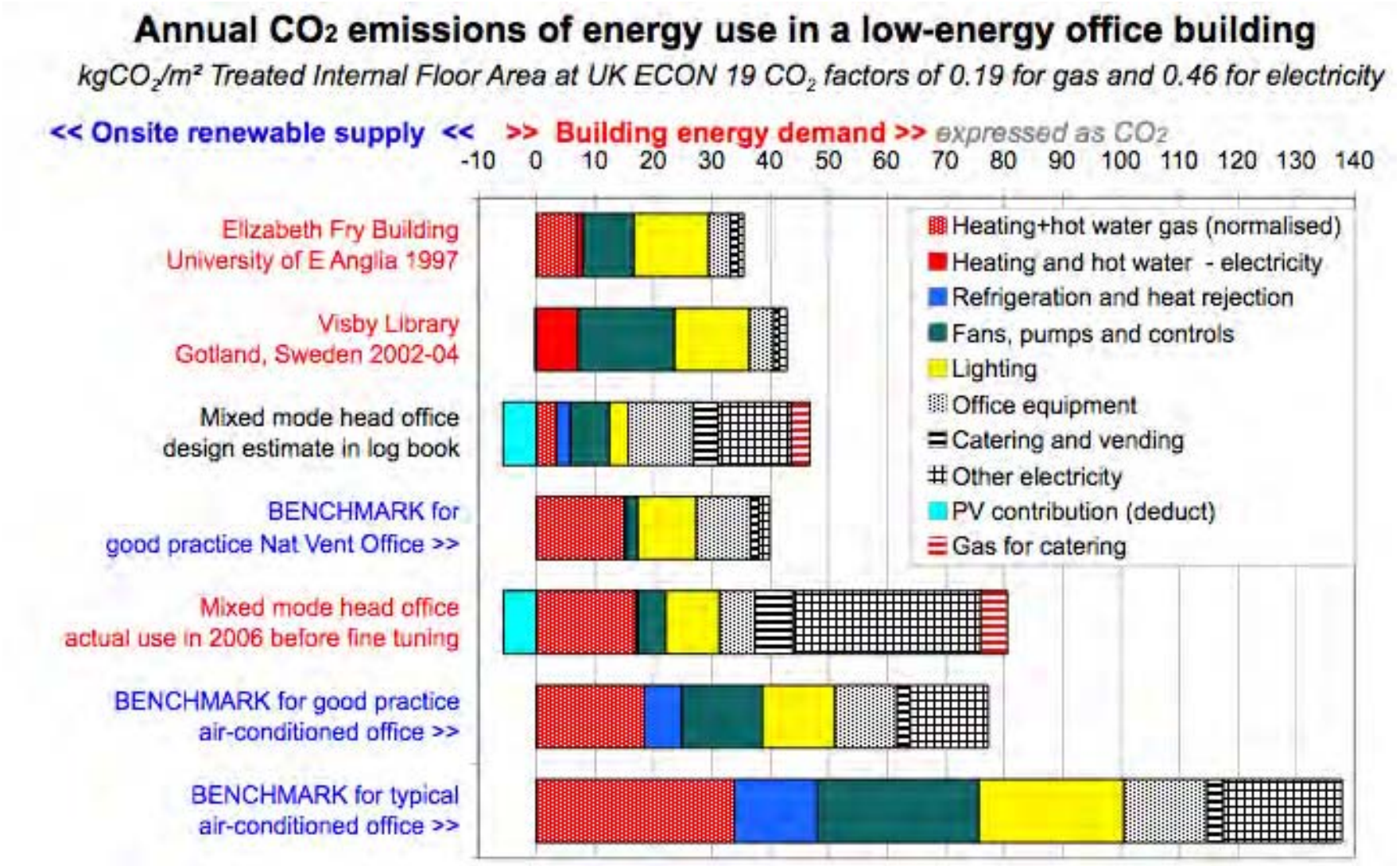
Expectations Management: an example

5: it's not all bad news, and the feedback is vital



We must learn from the fine structure:

6: how it relates to two other low-energy buildings



CIBSE TM22 begins show the way *to get into detail more transparently, but needs updating, to have more on design intent, and be more usable*

www.usablebuildings.co.uk