Oxford Brookes University
5 November 2025

INSIGHTS FROM BUILDING PERFORMANCE EVALUATION STUDIES

Bill Bordass

USABLE BUILDINGS
www.usablebuildings.co.uk

Insights from Building Performance Evaluation
OUTLINE

PART 1
Introduction and background

BREAK

PART 2
Some findings and their implications

BREAK

PART 3
A possible future

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PART 1
Introduction and Background

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Building performance in use is in the public interest

- Buildings last a long time, well beyond the time horizons of their creators, with many players involved in different roles.
- As building users, the whole population has an interest in them working better in every respect.

- **Now we want to improve the performance of the new, and particularly the existing stock,** *especially (but by no means only) in terms of energy and carbon.* ***BUT …***
- feedback loops from performance in use to design, building and policymaking are poorly closed, *a disastrous oversight.*

SO DO WE UNDERSTAND WHAT WE ARE DOING?

BPE TO THE RESCUE ?

Post-Occupancy Evaluation or Building Performance Evaluation?

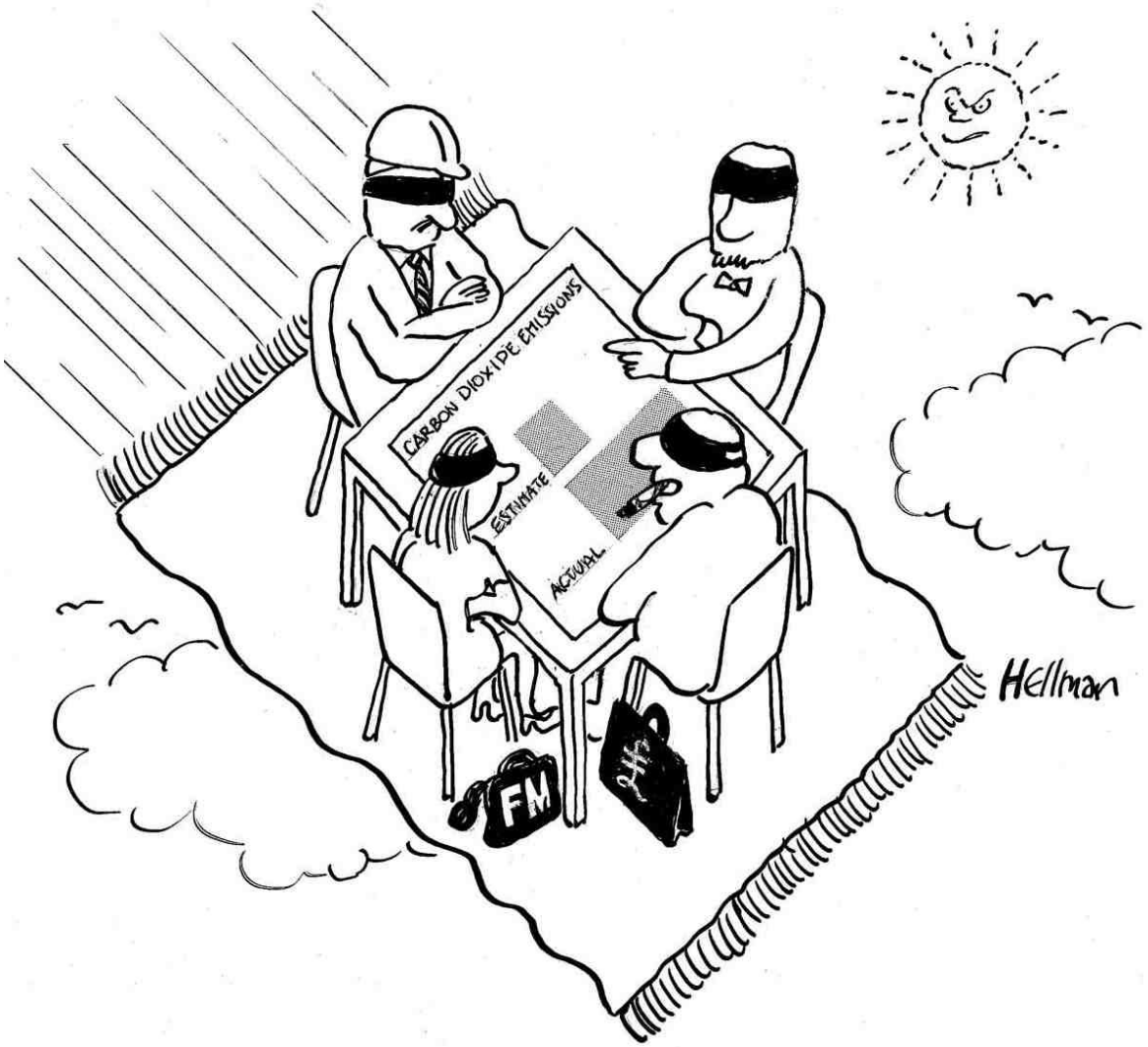
I prefer **Building Performance Evaluation,** *as it can cover any type of investigation, at any depth, at any time.*

Post-Occupancy Evaluation

- Exposes a construction industry perspective, *with handover seen as the end, not the beginning!*
- *Often regarded as academic and mostly about perceptions.*

***POE** is a useful term for BPE that is well-integrated with the activities of the client, design, building and management team when procuring or changing a building.*

24 years after I commissioned this, *many players remain ignorant of the true outcomes of their projects*



SOURCE: by Louis Hellman for cover of W Bordass, *Flying Blind,* Association for the Conservation of Energy, London, (2001).

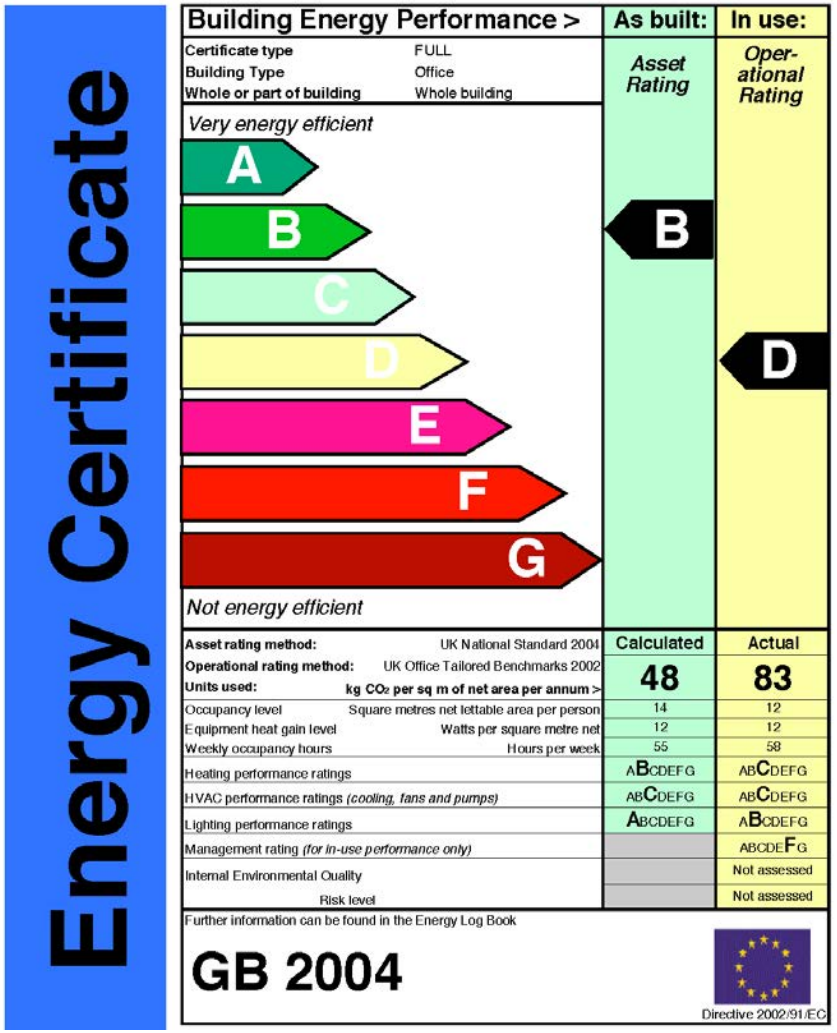
It might have been very different
had government taken energy certificates seriously

Ambitions of Europrosper research project 2000-04:

Display energy certificates based on actual energy use, not theoretical.
Achieved for public buildings only, but not supported.

Transparency between design expectations and in-use performance outcomes.
Not supported.

Multiple performance indicators
But benchmarking not supported.



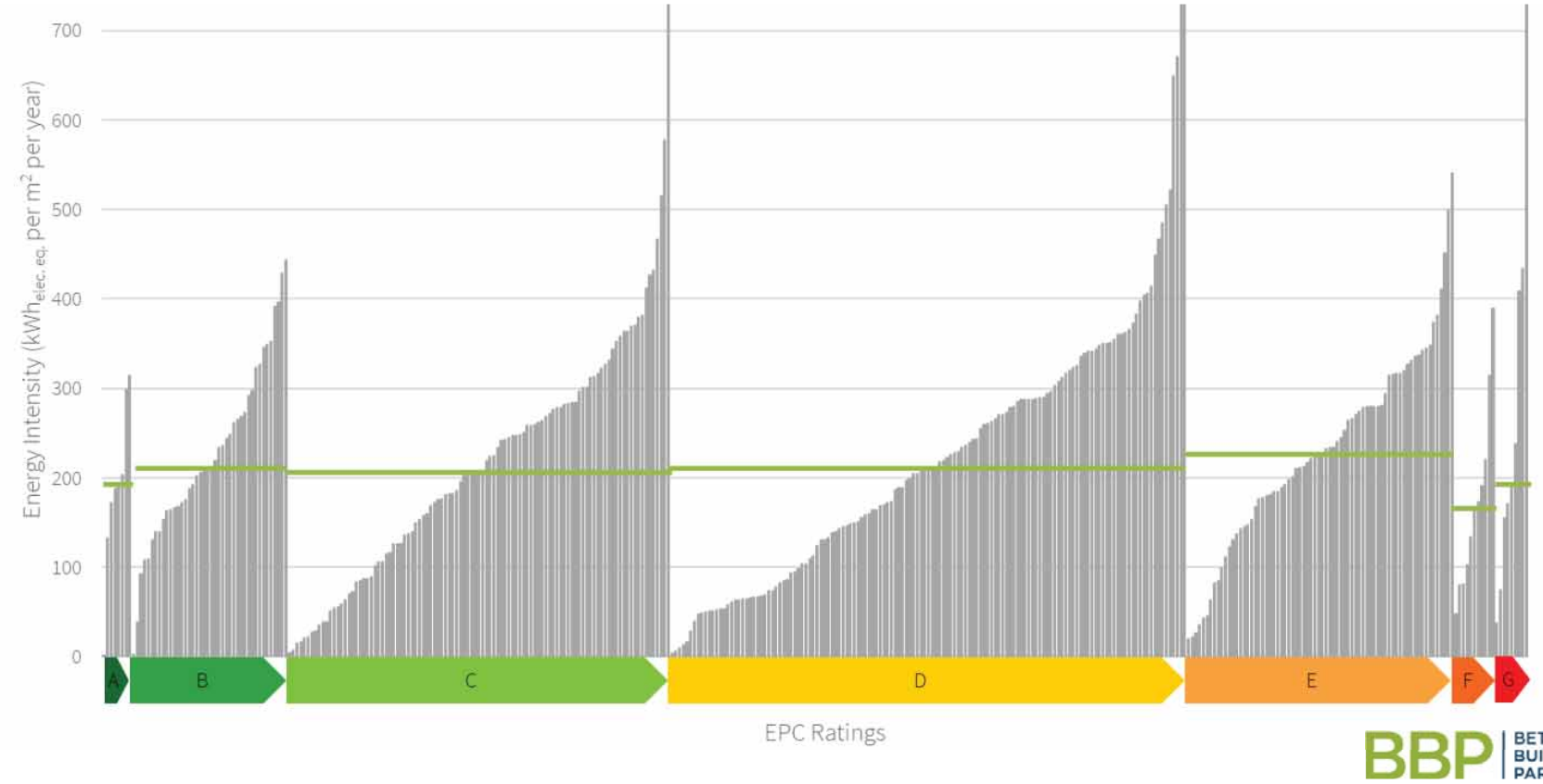
Why aren't designers and builders better tuned in to outcomes?

- Not what clients or government have asked them to do: *"hand over and walk away" is systemically embedded in standard procedures and contracts, so follow-through is not part of the standard offering*.
- Clients and government haven't set aside time and money for tuning-up after handover, *and often prefer to bury any bad news.*
- The industry and the associated professions didn't fill the vacuum created while central and local government progressively outsourced its technical expertise, research and performance feedback work.
- The policy emphasis has been on construction, not performance in use, *even when feedback information has been revealing problems.*
- Rigid divisions between funding of capital and operational costs – *getting worse if anything, in spite of all the talk of life cycle analysis.*
- Worries about insurance risks, exacerbated following the 2017 Grenfell Tower fire,
  BUT follow through is essential to learning and risk management.

Are the tools we use sometimes merely rituals?

Office actual energy use/m² NLA vs. EPC Grade

A Dysfunctional Market



BBP BETTER BUILDINGS PARTNERSHIP

FOR MORE SEE: www.betterbuildingspartnership.co.uk/our-priorities/measuring-reporting/design-performance

Are the tools we use sometimes merely rituals?

National Audit Office report on wall insulation

Department for Energy Security & Net Zero

Ofgem

Research and analysis

Solid wall insulation installed under ECO4 and GBIS: Statistical audit results

Published 13 October 2025

Applies to England, Scotland and Wales

Contents

Background
Results
Sampling approach
Conclusions
Annex: Classification of non-compliance

Print this page

This report summarises the results of the randomised samples of audits which were commissioned by Ofgem on behalf of DESNZ in order to understand the extent of non-compliance in Solid Wall Insulation (SWI) measures installed under the fourth iteration of the Energy Company Obligation (ECO4), and the Great British Insulation Scheme (GBIS).

The results showed that a majority (92%) of External Wall Insulation (EWI) installations and a large minority (27%) of Internal Wall Insulation (IWI) installations under these schemes were found to have at least one major technical non-compliance, which will affect the performance of the system. In addition, a small percentage of installations (6% of EWI and 3% of IWI installations) were found to have health and safety risks to the occupants.

SOURCE: www.gov.uk/government/publications/solid-wall-insulation-installed-under-eco4-and-gbis-statistical-audit-results/solid-wall-insulation-installed-under-eco4-and-gbis-statistical-audit-results

Academics and policymakers often ignore Case Studies, *saying they are anecdotal:* ***THEY ARE NOT!***

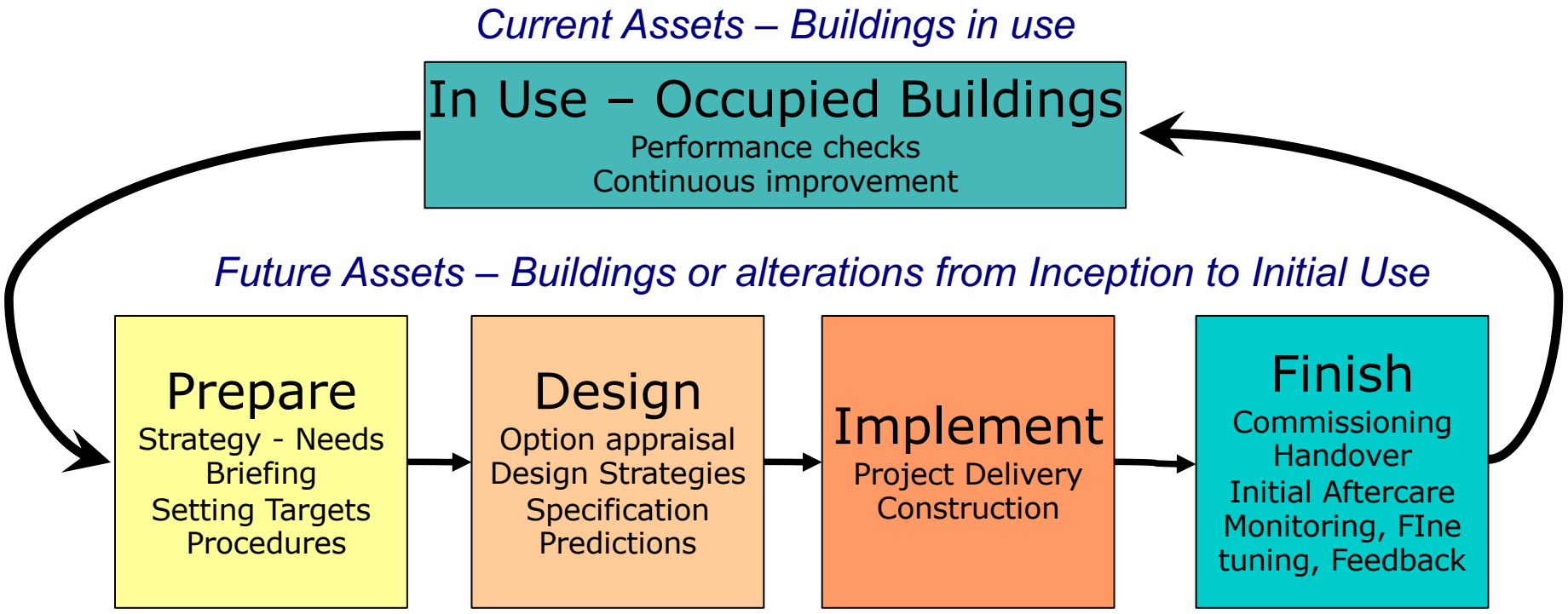
FIVE MISUNDERSTANDINGS *(after Flyvbjerg)*

1. *General knowledge is better than context-specific knowledge.*
   WRONG: *They complement each other.*
2. *You can't begin to generalise from a single case.*
   WRONG: *Individual cases and outliers can be bellwethers.*
3. *They might help you make hypotheses, but other methods are better for hypothesis-testing and theory-building.*
   WRONG: *They can also test hypotheses, using multiple methods.*
4. *They have a bias to confirming the investigator's bias.*
   NOT REALLY: *They often provide new and richer insights,*
   BUT *they need to be done with a degree of independence.*
5. *They do not let one develop general propositions and theories.*
   BUT: *They do help us develop coherent strategies for the future.*

Why do people ignore advance warning signals - the dead canary in the coal mine? **SEEKING MORE DATA IS OFTEN A DELAYING TACTIC.**

REFERENCE: B Flyvbjerg, *Five misunderstandings about case study research,* Qualitative Enquiry ***12***, 219-245 (2006),

Opportunities to use BPE
over the life cycle of a project, or a building

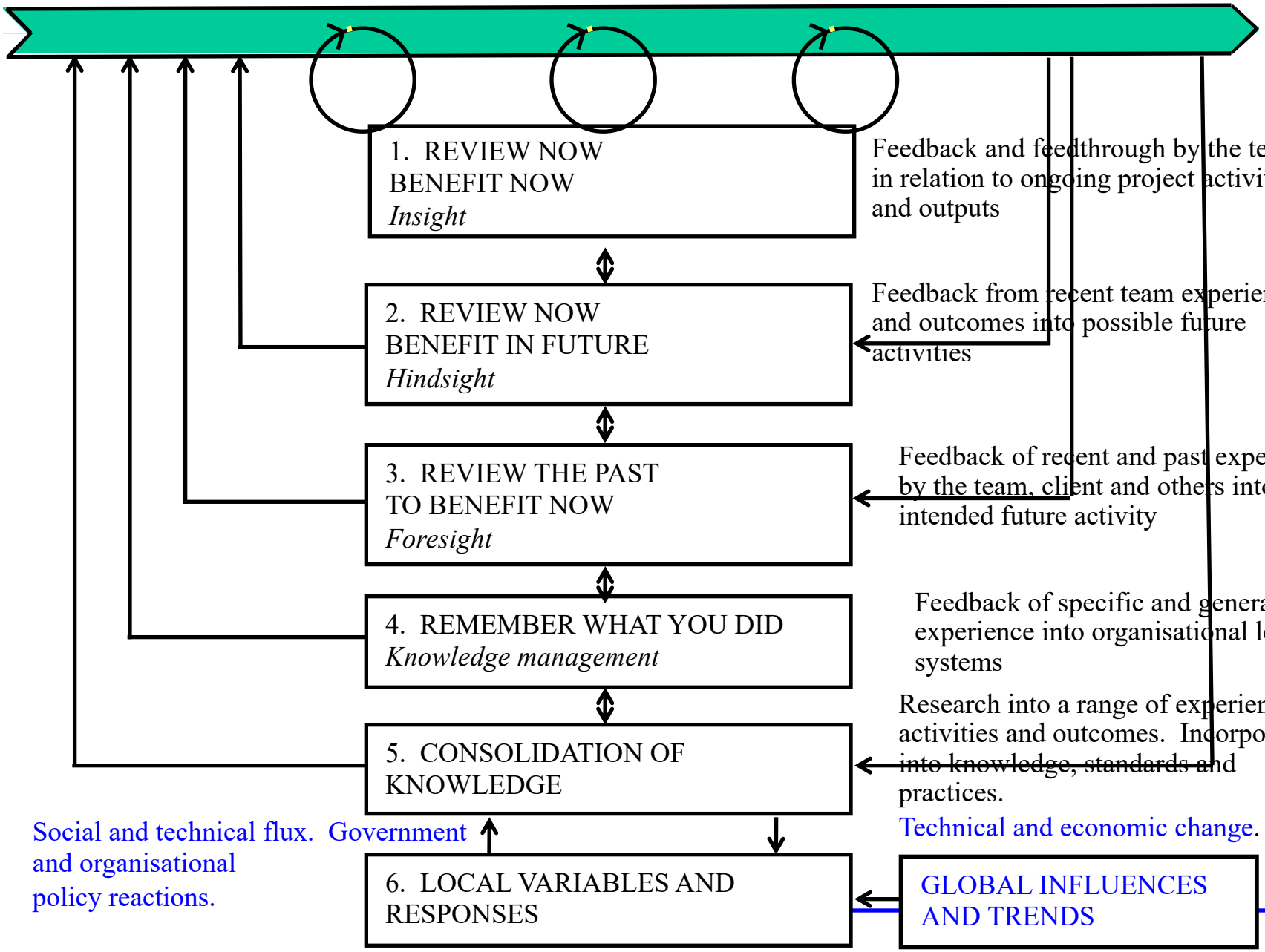


A wide range of activities, feeding into nested feedback loops

(see next slide)

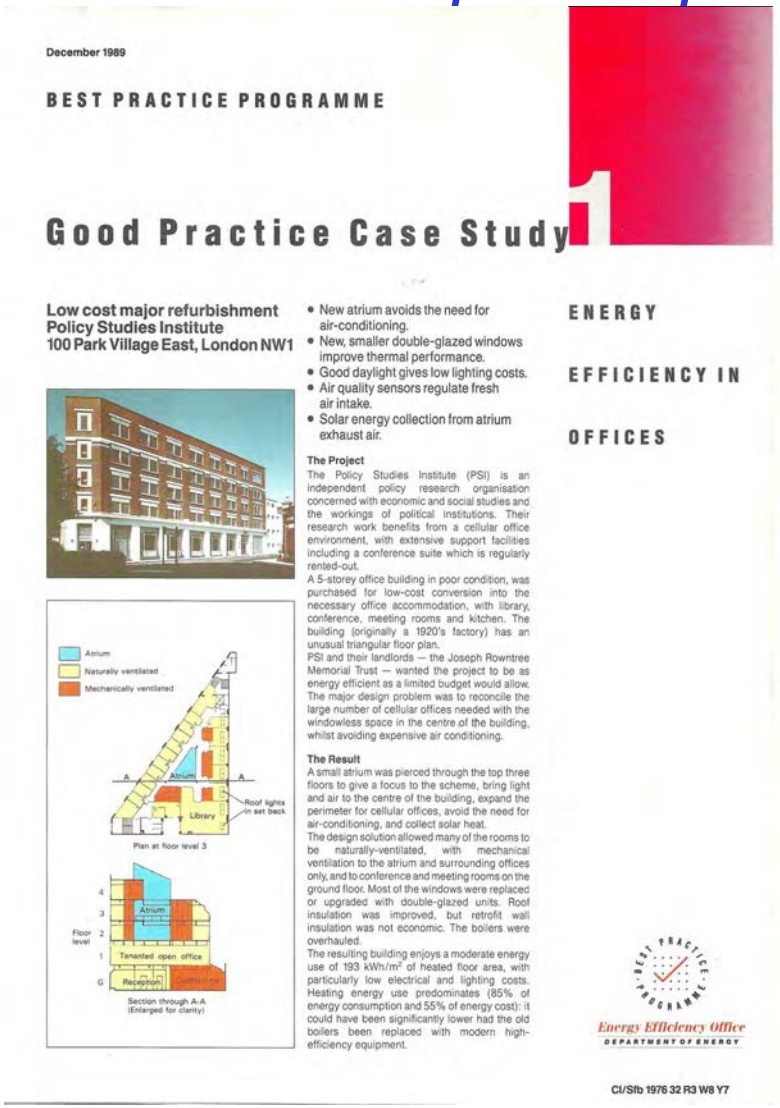
Client ***Design and Building team*** ***Users and facilities managers***

Justification Briefing and design Implementation Initial use Normal use



GETTING WELL-PERFORMING BUILDINGS:

What helped to put us on the track (1989)?



December 1989

BEST PRACTICE PROGRAMME

Good Practice Case Study 1

ENERGY EFFICIENCY IN OFFICES

Low cost major refurbishment
Policy Studies Institute
100 Park Village East, London NW1

- New atrium avoids the need for air-conditioning.
- New, smaller double-glazed windows improve thermal performance.
- Good daylight gives low lighting costs.
- Air quality sensors regulate fresh air intake.
- Solar energy collection from atrium exhaust air.

The Project

The Policy Studies Institute (PSI) is an independent policy research organisation concerned with economic and social studies and the workings of political institutions. Their research work benefits from a cellular office environment, with extensive support facilities including a conference suite which is regularly rented-out.

A 5-storey office building in poor condition, was purchased for low-cost conversion into the necessary office accommodation, with library, conference, meeting rooms and kitchen. The building (originally a 1920's factory) has an unusual triangular floor plan.

PSI and their landlords — the Joseph Rowntree Memorial Trust — wanted the project to be as energy efficient as a limited budget would allow. The major design problem was to reconcile the large number of cellular offices needed with the windowless space in the centre of the building, whilst avoiding expensive air conditioning.

The Result

A small atrium was pierced through the top three floors to give a focus to the scheme, bring light and air to the centre of the building, expand the perimeter for cellular offices, avoid the need for air-conditioning, and collect solar heat.

The design solution allowed many of the rooms to be naturally-ventilated, with mechanical ventilation to the atrium and surrounding offices only, and to conference and meeting rooms on the ground floor. Most of the windows were replaced or upgraded with double-glazed units. Roof insulation was improved, but retrofit wall insulation was not economic. The boilers were overhauled.

The resulting building enjoys a moderate energy use of 193 kWh/m² of heated floor area, with particularly low electrical and lighting costs. Heating energy use predominates (85% of energy consumption and 55% of energy cost): it could have been significantly lower had the old boilers been replaced with modern high-efficiency equipment.

Atrium
Naturally ventilated
Mechanically ventilated
Atrium
Library
Roof lights in set back
Plan at floor level 3
Floor level
Atrium
Tenanted open office
Reception
Section through A-A (Enlarged for clarity)

Energy Efficiency Office
DEPARTMENT OF ENERGY

CI/SfB 1976 32 R3 W8 Y7

1998: Energy Efficiency Best Practice programme replaced the Energy Efficiency Demonstration Scheme, *where results had been disappointing.*

Case Study 1 performed well in terms of its energy use, particularly electricity.

It had also been studied as part of the Building Use Studies (BUS) *Office Environment Survey* of occupant satisfaction in 50 buildings, where it also performed unusually well.

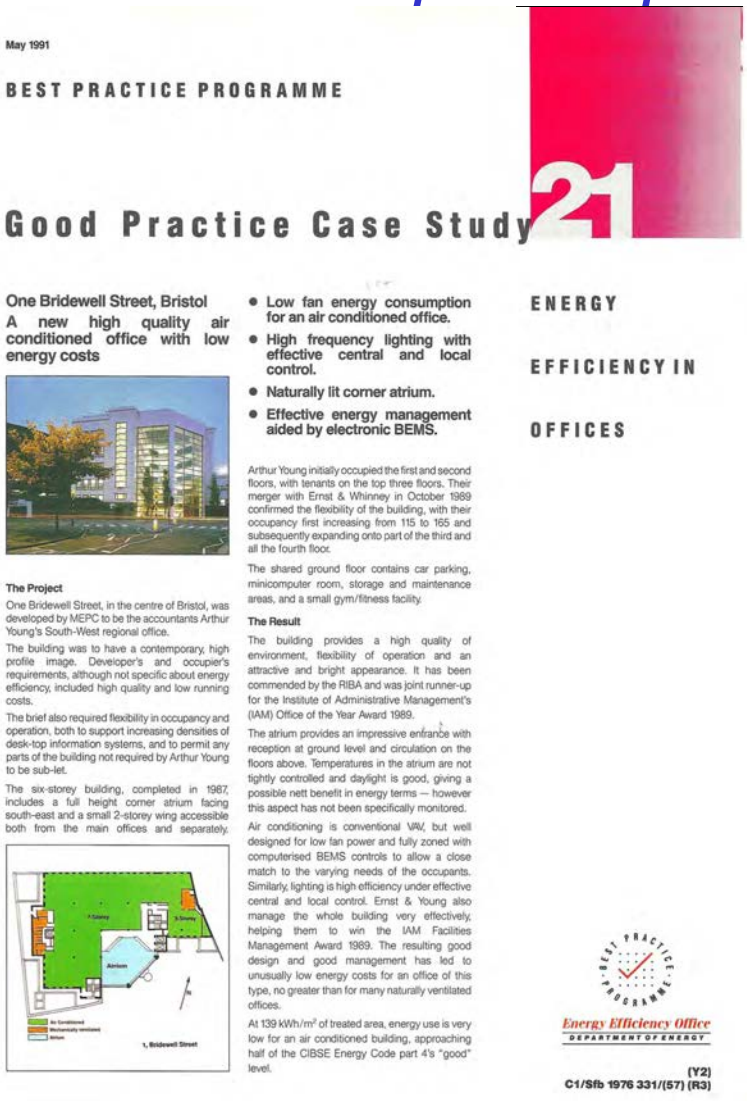
Was there a link?

We sought opportunities to combine occupant and energy surveys.

SOURCE: Energy Efficiency Best Practice Programme, Case Study 1, *Policy Studies Institute* (December 1989)

GETTING WELL-PERFORMING BUILDINGS:

What helped to put us on the track (1991)?



May 1991

BEST PRACTICE PROGRAMME

Good Practice Case Study 21

ENERGY EFFICIENCY IN OFFICES

One Bridewell Street, Bristol
A new high quality air conditioned office with low energy costs

- Low fan energy consumption for an air conditioned office.
- High frequency lighting with effective central and local control.
- Naturally lit corner atrium.
- Effective energy management aided by electronic BEMS.

The Project

One Bridewell Street, in the centre of Bristol, was developed by MEPC to be the accountants Arthur Young's South-West regional office.

The building was to have a contemporary, high profile image. Developer's and occupier's requirements, although not specific about energy efficiency, included high quality and low running costs.

The brief also required flexibility in occupancy and operation, both to support increasing densities of desk-top information systems, and to permit any parts of the building not required by Arthur Young to be sub-let.

The six-storey building, completed in 1987, includes a full height corner atrium facing south-east and a small 2-storey wing accessible both from the main offices and separately.

Arthur Young initially occupied the first and second floors, with tenants on the top three floors. Their merger with Ernst & Whinney in October 1989 confirmed the flexibility of the building, with their occupancy first increasing from 115 to 165 and subsequently expanding onto part of the third and all the fourth floor.

The shared ground floor contains car parking, minicomputer room, storage and maintenance areas, and a small gym/fitness facility.

The Result

The building provides a high quality of environment, flexibility of operation and an attractive and bright appearance. It has been commended by the RIBA and was joint runner-up for the Institute of Administrative Management's (IAM) Office of the Year Award 1989.

The atrium provides an impressive entrance with reception at ground level and circulation on the floors above. Temperatures in the atrium are not tightly controlled and daylight is good, giving a possible nett benefit in energy terms — however this aspect has not been specifically monitored.

Air conditioning is conventional VAV, but well designed for low fan power and fully zoned with computerised BEMS controls to allow a close match to the varying needs of the occupants. Similarly, lighting is high efficiency under effective central and local control. Ernst & Young also manage the whole building very effectively, helping them to win the IAM Facilities Management Award 1989. The resulting good design and good management has led to unusually low energy costs for an office of this type, no greater than for many naturally ventilated offices.

At 139 kWh/m² of treated area, energy use is very low for an air conditioned building, approaching half of the CIBSE Energy Code part 4's "good" level.

Energy Efficiency Office
DEPARTMENT OF ENERGY

(Y2)
C1/Sfb 1976 331/(57) (R3)

This air-conditioned building had an energy performance similar to some of the good naturally-ventilated buildings.

An office in London, which had the same design team and similar technical specification had three times the carbon footprint from annual energy use.

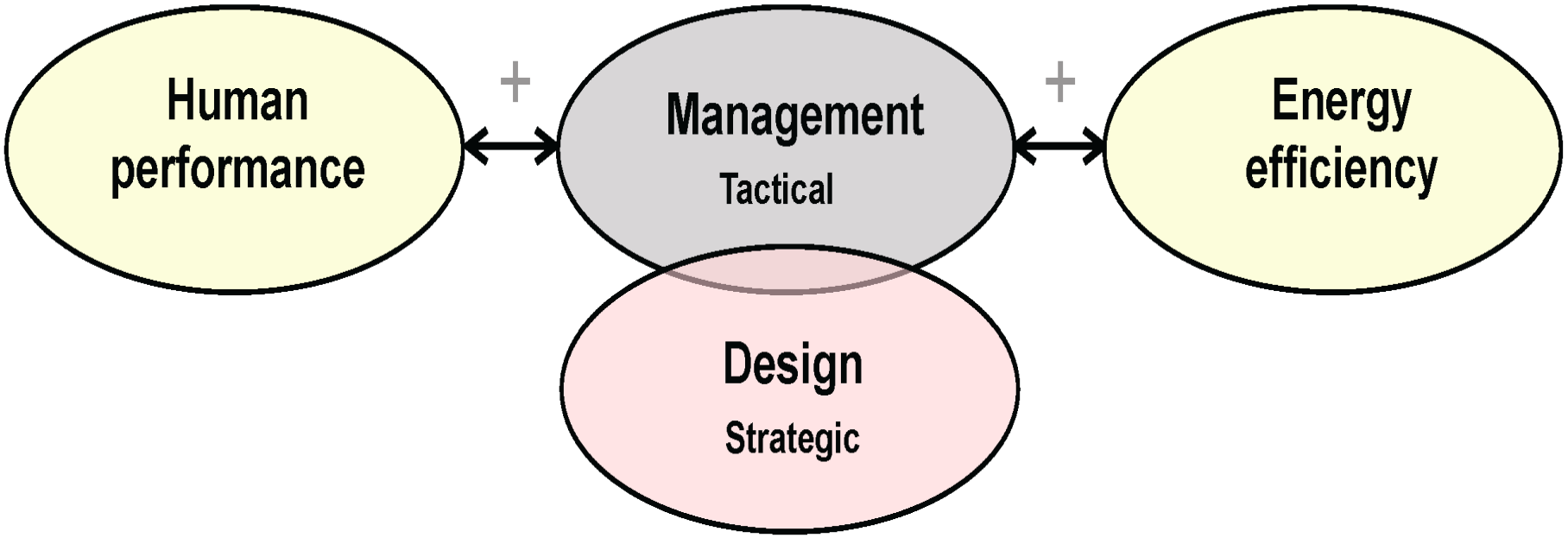
What was going on?

We sought opportunities to do a deeper investigation using mixed methods, *including an occupant survey by Building Use Studies.*

SOURCE: Energy Efficiency Best Practice Programme, Case Study 21. *One Bridewell Street* (May1991)

Where good things happened …

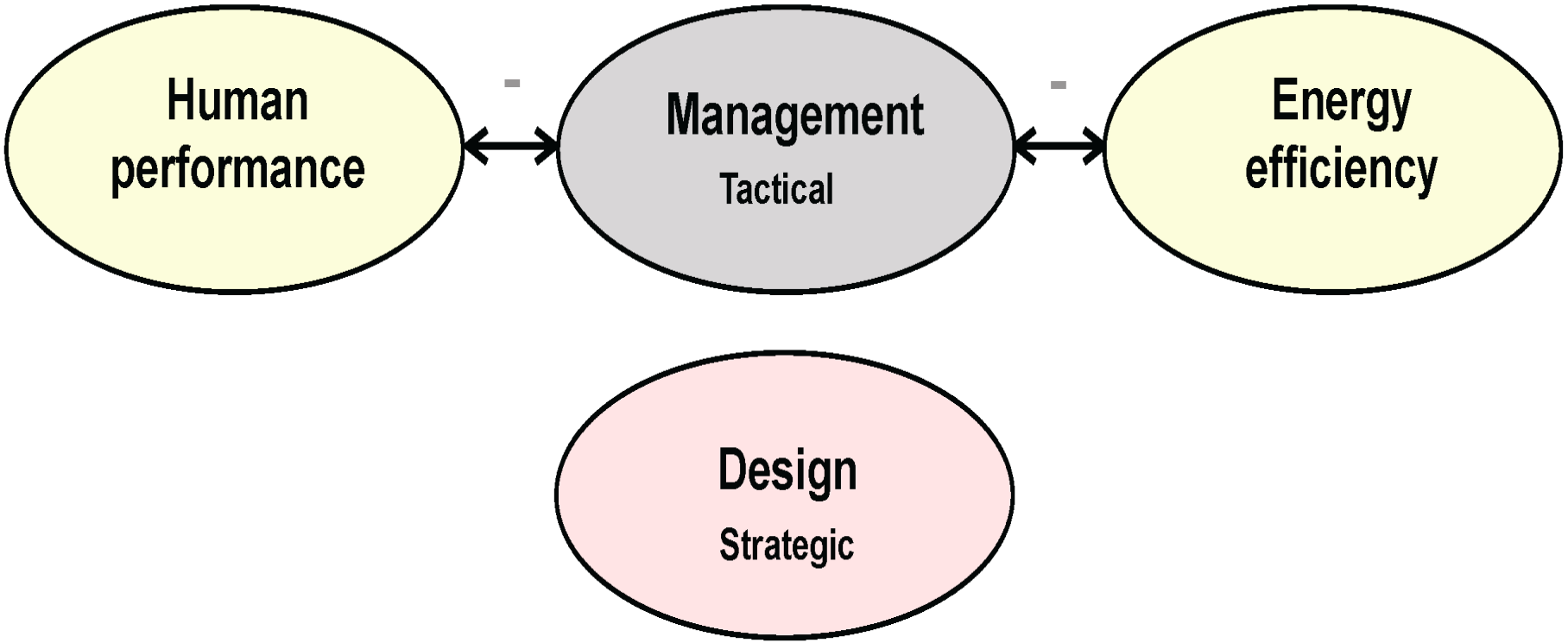
associations of low energy with happy occupants



The better-performing buildings tended to be where there was a better understanding of user requirements during procurement, and better follow-through to good management in use.

One could usually name the individual or individuals responsible for championing the building in use and driving the virtuous circles.

… and where they didn't
no positive associations



Without this understanding and commitment - *linking design to use and management* – performance in use could be disappointing, in terms of energy and/or occupant satisfaction. *So we need to bring out the leaders*.

You can't tell how good your building is
… *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

The original Elizabeth Fry Probe paper was published in *Building Services Journal,* 37-41 (April 1998).

“Any building without a feedback system is stupid. It will continue to make the same dumb mistakes, rather than interesting new ones.”

AMORY LOVINS
Rocky Mountain Institute

It was the practice, not just the product

"Soft" factors for success at the Elizabeth Fry Building, UEA

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

- A good client
- A good brief *incorporating the client's previous experience.*
- A good team *(worked together before on the site).*
- Specialist support *(especially 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).*

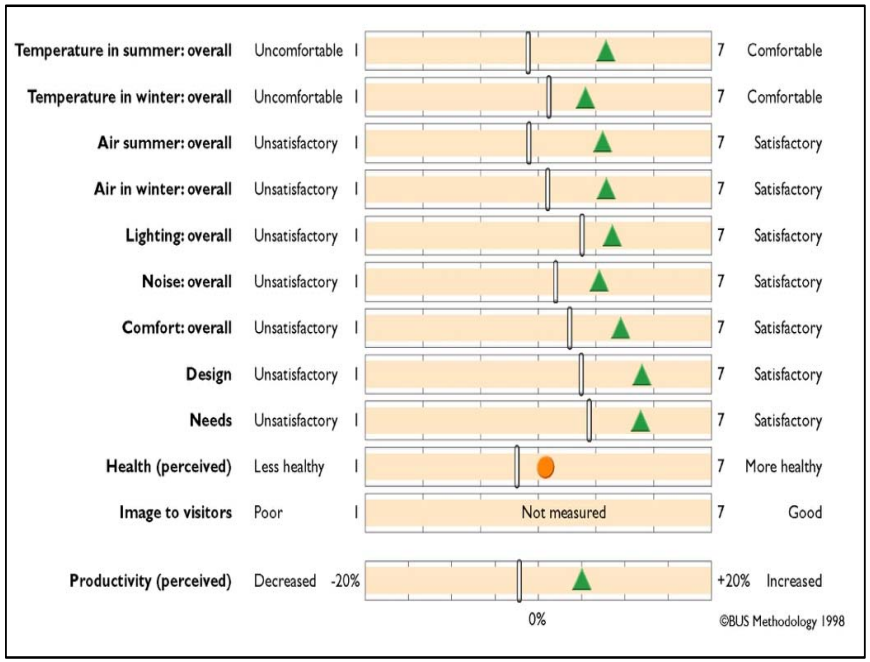
- Well-built *(attention to detail, but still room for improvement).*
- Well controlled *(but only eventually, after monitoring and refit).*
- Post-handover support *(triggered by independent monitoring).*
- Management vigilance *but was it sustained?*

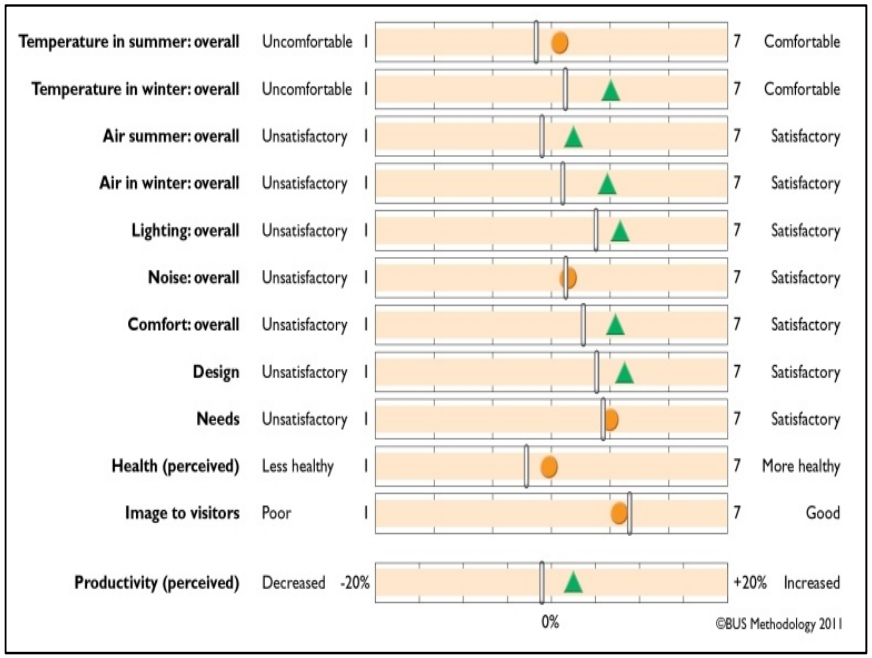
SOURCE: W Bordass et al, *Assessing building performance in use 5*, BR&I **29** (2), 144-157 (March-April 2001), Figure 6.

E Fry Revisit – *Pressure test Sept 2011*

Elizabeth Fry Revisit – *BUS Occupant Survey*

1998 *2011*





Average scores from BUS occupant survey questionnaire:

Vertical bars = benchmark medians from similar buildings.

Green triangles = significantly better than benchmark.

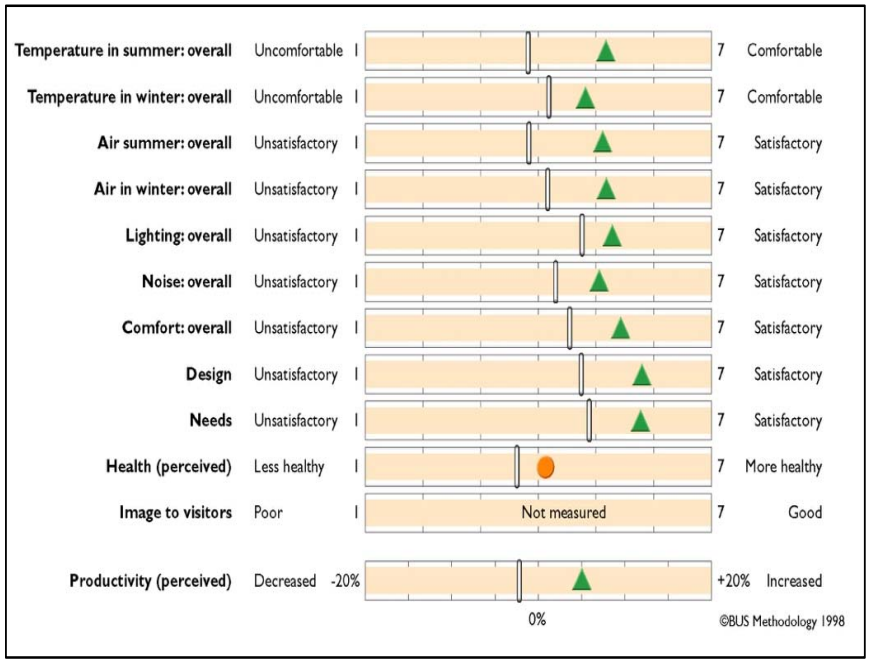
Orange circles = indistinguishable from benchmark, Red squares = worse

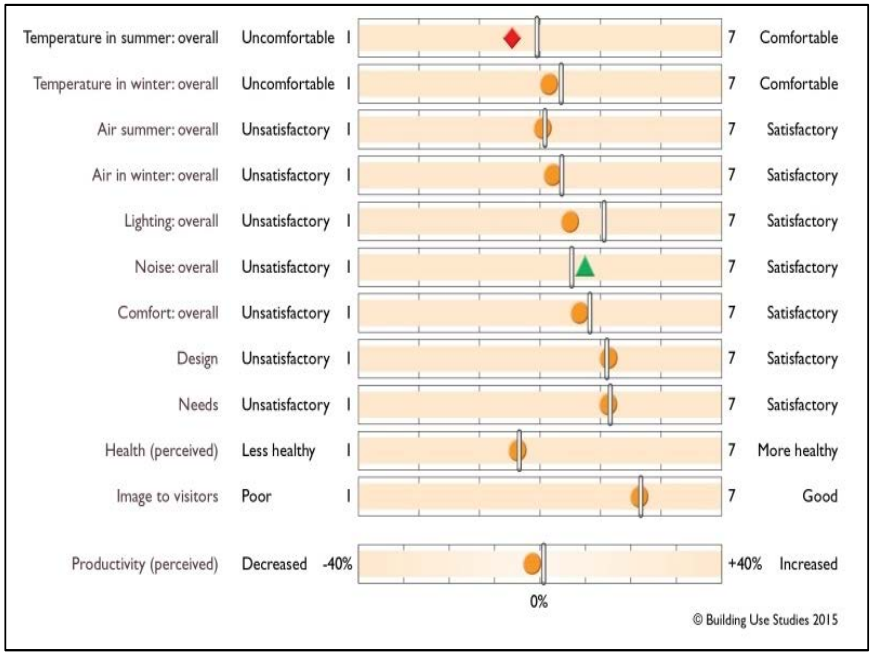
Some degradation over the years, but recognisably similar

SOURCE: W Bordass and A Leaman, *The Elizabeth Fry Building revisited,* Building Services Journal, 30-36, (March 2012).

Elizabeth Fry Revisit – *BUS Occupant Survey*

1998 *2015*





Average scores from BUS occupant survey questionnaire:

Vertical bars = benchmark medians from similar buildings.

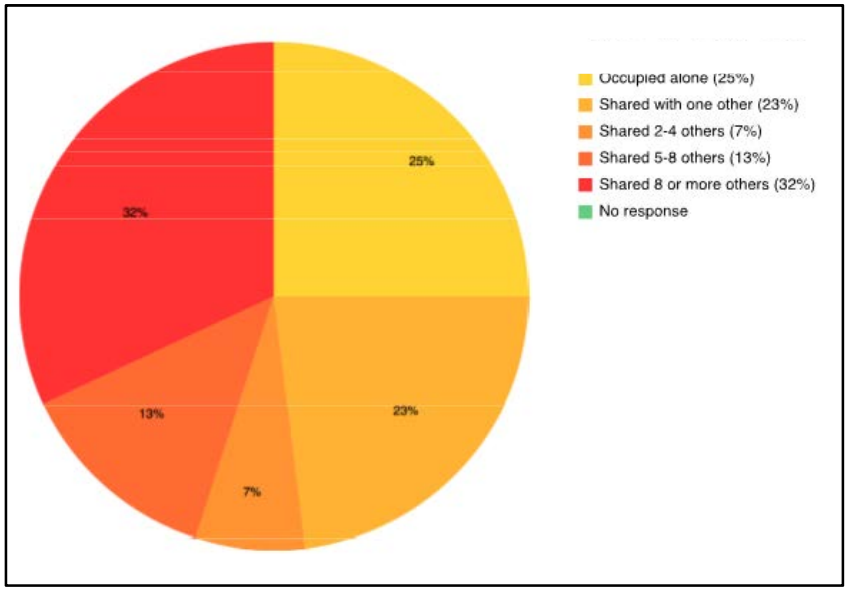
Green triangle = significantly better than benchmark.

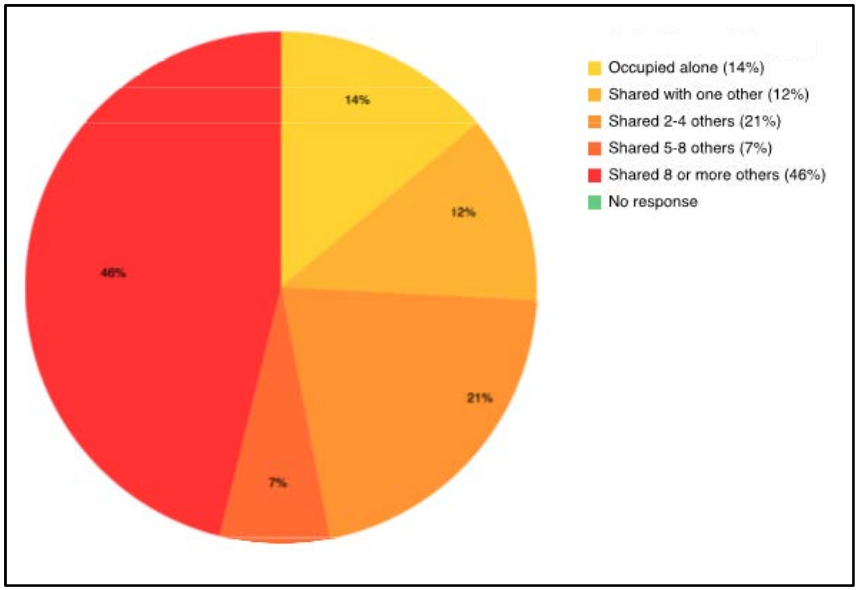
Orange circle = indistinguishable from benchmark, Red diamond = worse.

Now very much average – WHAT WENT WRONG?

SOURCE: R Bunn and L Marjanovich, *Occupant satisfaction signatures: Longitudinal studies,* CIBSE Symposium (April 2016).

BUS occupant questionnaire responses on room size at Elizabeth Fry: 2011 and 2015





Fewer people in individual or twin offices: *Down from 48% to 26%.*
More people in offices with 3-8 people: *Up from 20% to 28%.*
More people in large shared spaces (8 or more): *Up from 32% to 46%.*

Managers and architects tend to like open-plan spaces – *but there is much more that can go wrong. COVID may have changed attitudes too.*

SOURCE: R Bunn and L Marjanovich, *Occupant satisfaction signatures: Longitudinal studies,* CIBSE Symposium (April 2016).

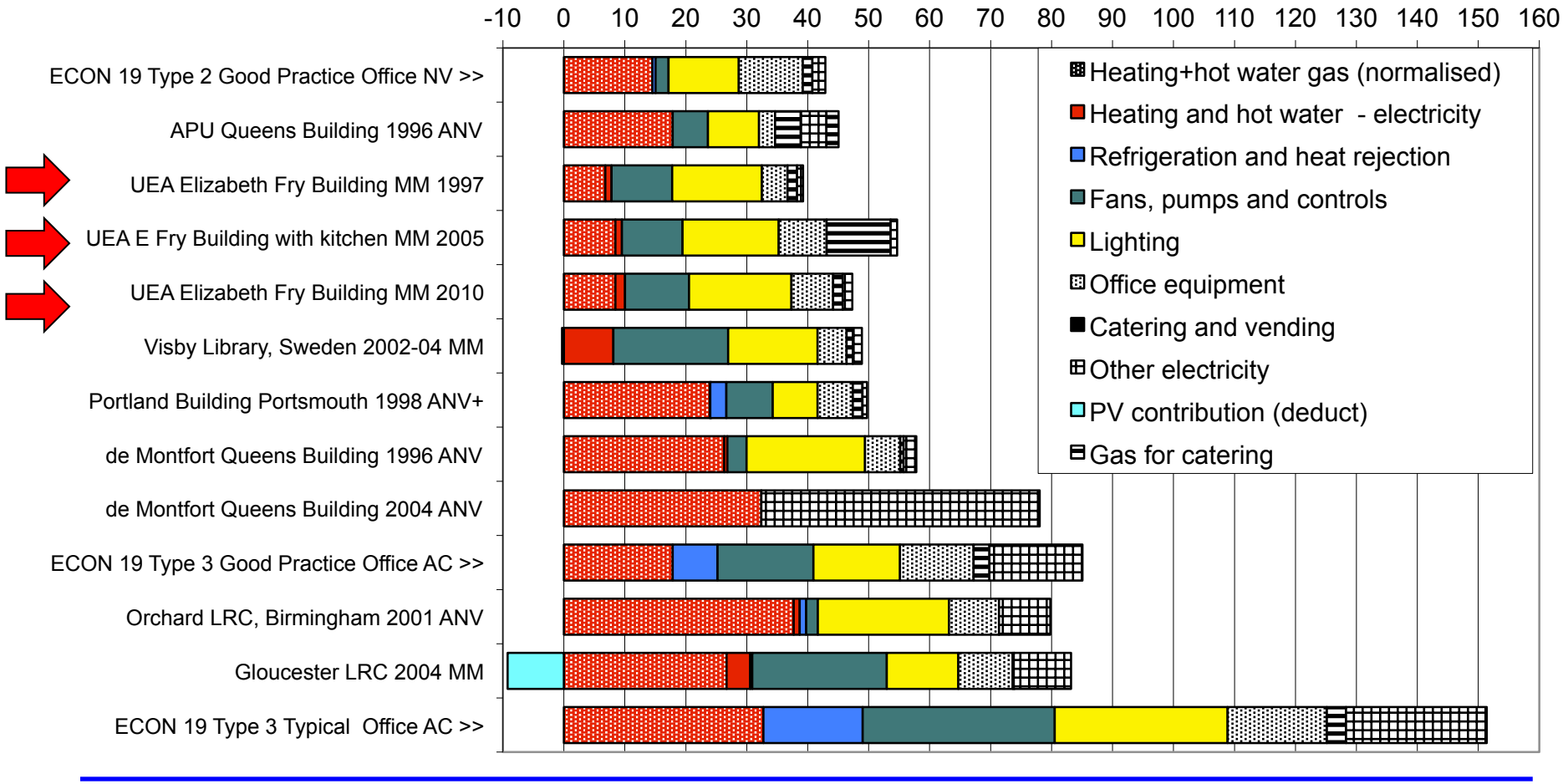
Here is one of those converted spaces

Increased occupant density: heat, noise, interruptions, etc., etc..
Loss of thermal mass of partitions and ceiling.
Trickle-charge cooling system with no local control can barely cope.
Contractor design. Less oversight by Estates or by professionals.

E Fry Revisit – Energy Performance

Annual CO_2 emissions from university buildings

kg/m² Treated Floor Area at UK CO_2 factors of 0.184 for gas and 0.525 for electricity



RIBA proposed a feedback stage 60 years ago in its **Plan of Work (1963) STAGE M**

PURPOSE

To analyse the management, construction and performance of the project.

TASKS TO BE DONE

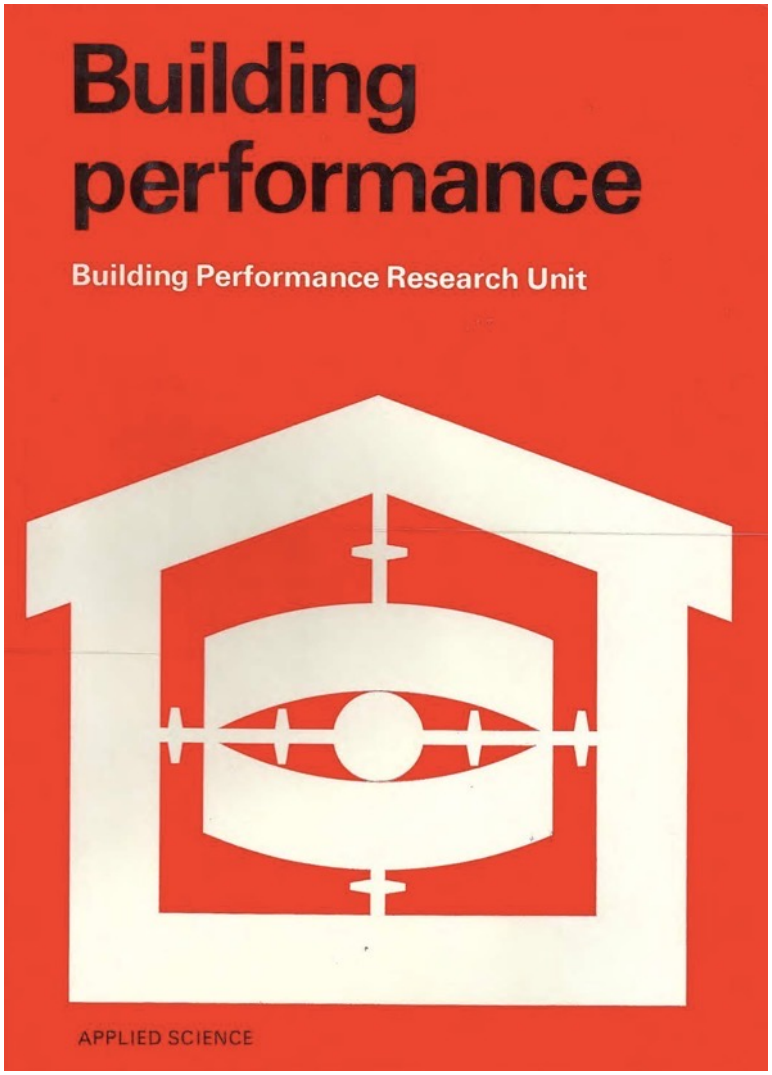
Analysis of job records.
Inspections of completed building.
Studies of building in use.

PEOPLE DIRECTLY INVOLVED

Architect, engineers, QS, contractor, client.

SO WHY ISN'T BPE ROUTINE FOR DESIGNERS TODAY?

Building performance evaluation started in some universities in the 1960s



Pioneers included the University of California, Berkeley and the Building Performance Research Unit at Strathclyde (BPRU).

However, after BPRU's seminal book in 1972, the subject failed to gather momentum, as it did not fit well with academic criteria, or get sustained client, government or industry support.

"*Unfortunately, interdisciplinary subjects have a way of escaping from any discipline whatever.*" … ERIC DREXLER

In 1972 the RIBA removed **Stage M: Feedback** from its publication ***Architect's Appointment.***

REFERENCE: T Markus et al, *Building Performance,* Applied Science Publishers (1972)

the tide also turned in government …

- Widespread disruption and disillusionment in the 1970s.
- Ascendancy of ideas about free markets, competition and choice; a *de facto* inefficient public sector, and *"no such thing as society".*
- Professionals began to be seen as an elitist conspiracy against the public, and were treated by government as just another business.
- The Rothschild Report 1972, advocated a customer-contractor relationship for government-sponsored applied research …
  but what happened to its idea of an intelligent government customer?
- Outsourcing and privatisation of professional skills and research capabilities from government *e.g. the Building Research Establishment.*
- Dismemberment of the Department of the Environment 1997-2002.

WHERE IS THE INSTITUTIONAL MEMORY?

Nobody else (e.g. professional institutions), has helped fill this gap effectively and provide continuity over the years – "the forgetting curve".

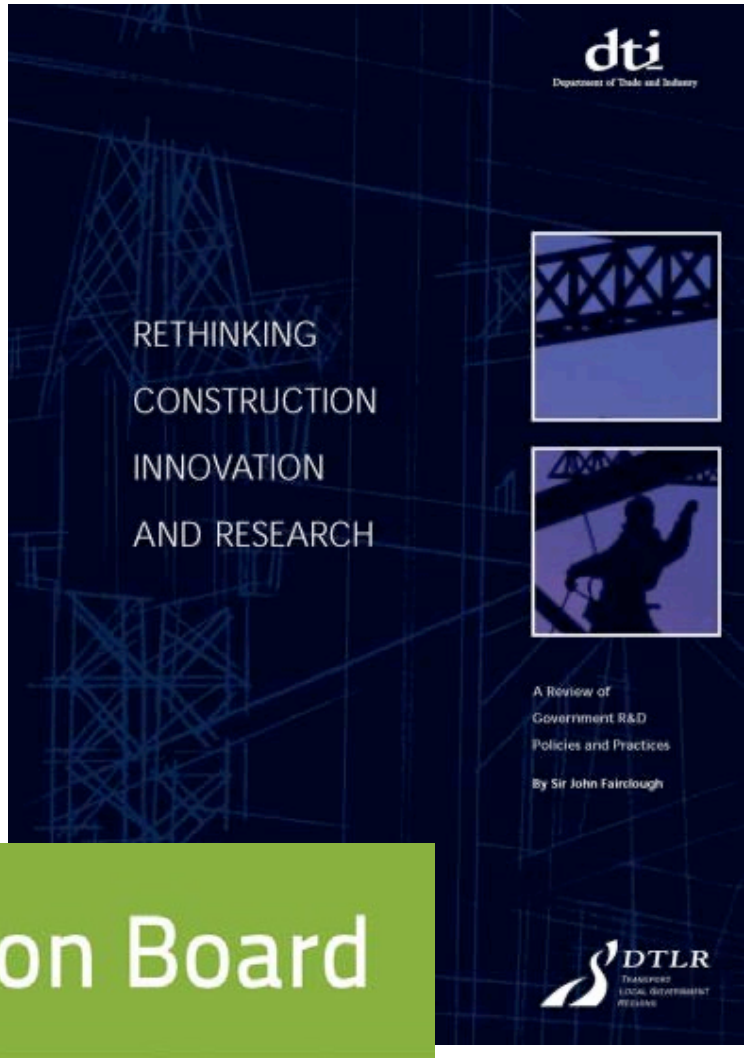
So policy is based more on hope, predictions, and lobbies, than true experience of what works and what really needs attending to.

Instead of responding to early signals, we react only to big crises.

Buildings policy has tended to focus on construction, *not performance in use …*

RETHINKING CONSTRUCTION

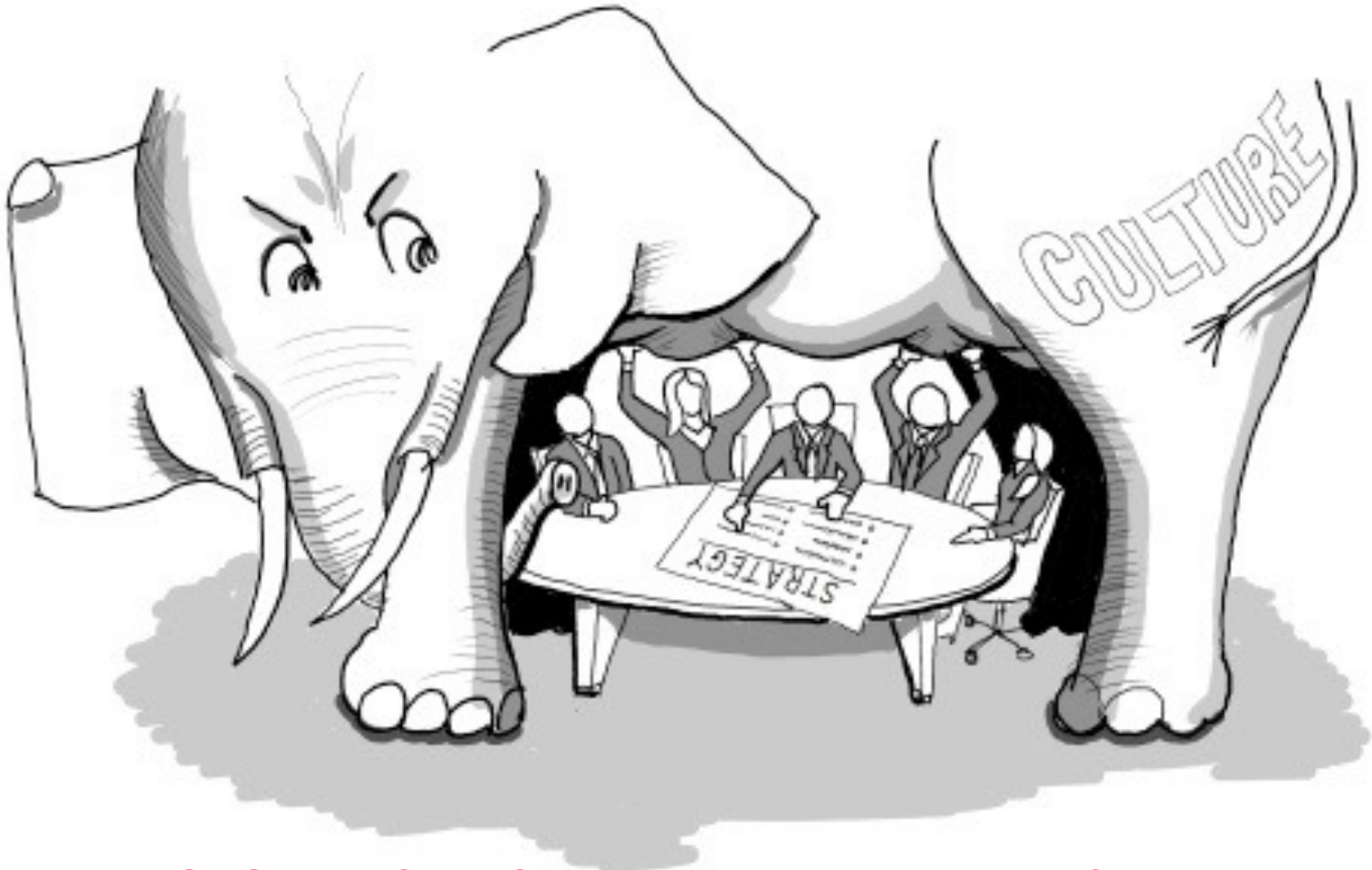
ORT OF THE CONSTRUCTION TASK FORCE



The Green Construction Board

REFERENCES: The Egan Report (DTI, 1998), the Fairclough Report (DTI and DTLR, 2002)

The elephant isn't in the room, *IT IS THE ROOM!*



WE HAVE A SYSTEMIC PROBLEM: Blindness to performance in use

It's not just the construction industry, it's the way we all go about things

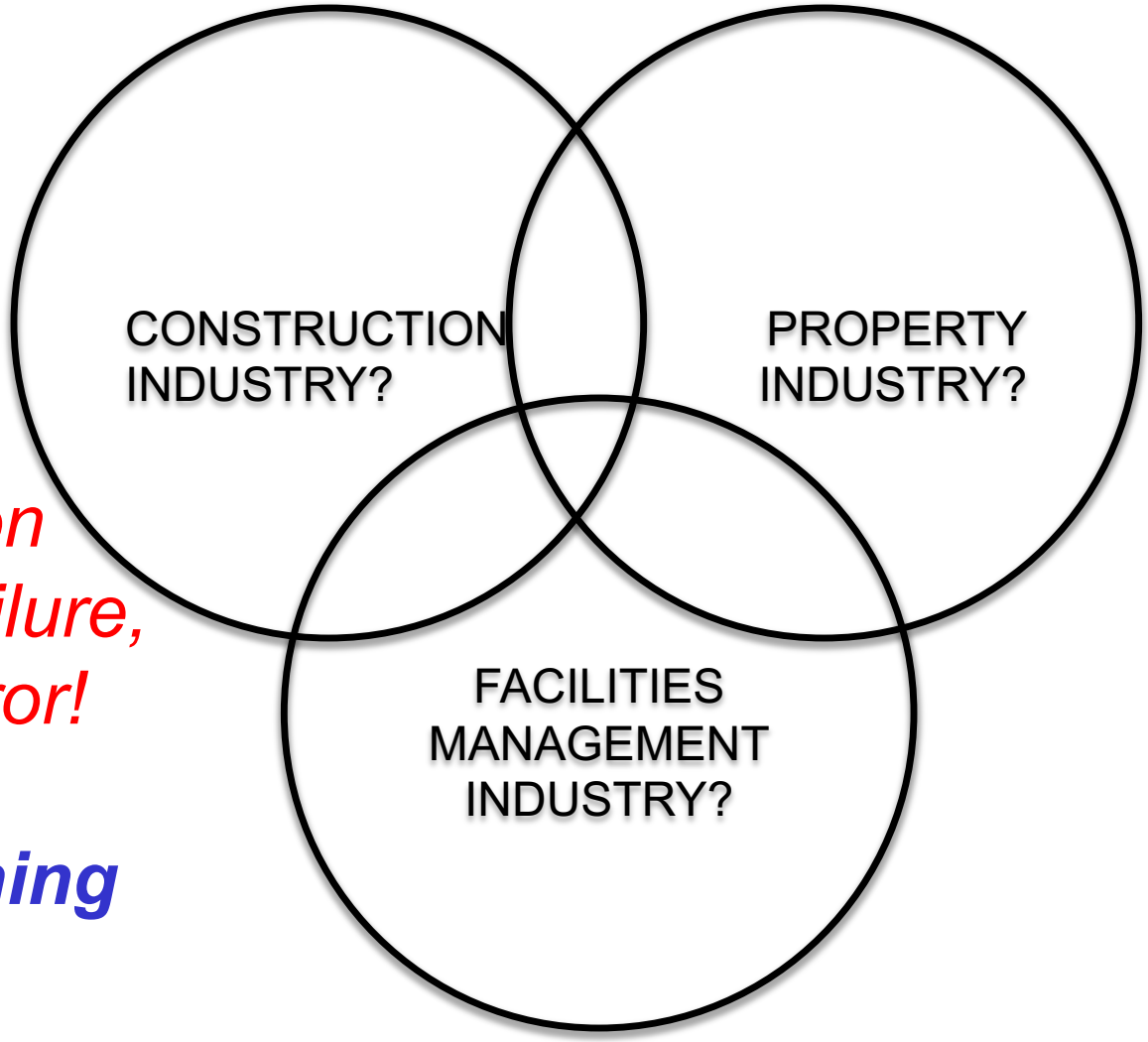
SOURCE: Bruce Flye, 2012, www.bruceflye.com/concept-graphics/illustrations/4092610

Which industry and market is really responsible for building performance in use?

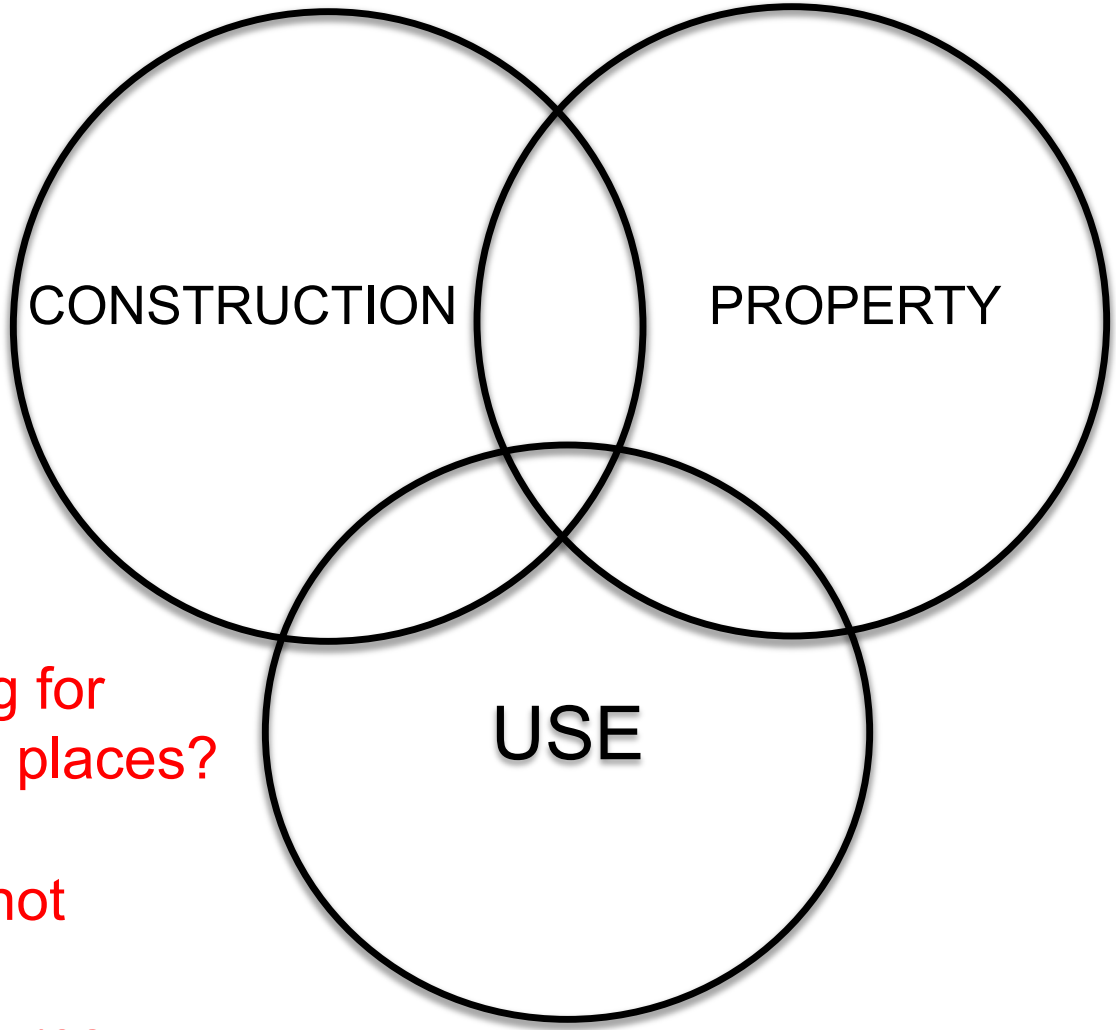
None of these:
it's much more complicated than that.

The lack of traction is not a market failure, but a category error!

We need something more …



There needs to be more shared territory, *with much more emphasis on use*



Do policymakers
really understand this …

or have they been looking for
the answers in the wrong places?

Performance in use has not
been well represented in
industry and policy measures.

Sustainability raises challenging moral and ethical dilemmas

- Work ‘after us’ and for ‘the other’.
- Intergenerational equity.
- Deferred impacts over long periods.
- Differential geographical and social impacts.
- Growing levels of uncertainty and unpredictability.

It needs vision, imagination, reflection and commitment

“[it] does not tempt us to be less moral than we might otherwise be; it invites us to be more moral than we could ever have imagined.” … MALCOLM BULL

RIBA Plan of Work 2013 let sustainability checkpoints be switched on and off ! *Fortunately the 2020 Plan doesn’t.*

SOURCES: S Hill, Edge debate, New Professionalism, 20 Feb 2013, M Bull, London Review of Books, 3-6, 24 May 2012

Some general conclusions

- If we are to meet the challenges of sustainability, the role of the building professional has to change.
- The industry needs to focus not just on inputs and outputs, but in-use outcomes.
- We must close the feedback loop and initiate virtuous circles of rapid improvement, involving all players.
- This is a systemic problem: the perspective needs to be wider than buildings and construction alone.
- Building performance in use needs to become an independent and properly-resourced knowledge domain, and managed in the public interest.

This should have woken everybody up …

but I fear it has been interpreted far too narrowly

Government response has been onerous safety regulation and control, ***not culture change***

Learn about the new Building Safety Regulator (BSR)

"The government is proposing changes to building safety law. These will protect people who live in high rise buildings and give new duties to the people who are responsible for the safety …."

SOURCE: HSE video at www.youtube.com/watch?v=YyOnPjkVyU8

WE NEED MORE THAN THIS: *The role of the building professional needs completely re-defining*

- There's a big job to do,
  making new and existing buildings more sustainable.
- We're short of money:
  we can't afford to spend it doing the wrong things.
- Our current procurement systems are not fit for purpose:
  we need to do things very differently.
- We can't change everything tomorrow …
  but we can change our attitudes to what we do.
- It's not a question of whether we can afford to change:
  We can't afford not to !
- WHEN DO WE START?
  NOW ! You can be the new leaders.

Recent confirmation of need for culture change

including from the head of the first Grenfell inquiry

In a recent lecture, Dame Judith Hackitt called on construction professionals and industry leaders to take their building safety responsibilities more seriously amidst an "*appalling attitude [that] continues to prevail*"

Speaking at the annual Sir James Wates lecture in late 2024, Dame Judith Hackitt said: "*I feel strongly that it is time for us to name and shame those who continue to try to game the new system.*"....The "*sobering speech*" titled 'In Search of the Leaders' saw Dame Judith share her concerns about the current direction of building safety. She noted that even with the recommendations of the Grenfell Tower Inquiry report and the implementation of the Building Safety Act (BSA) in 2022, there remained limited evidence of any kind of behavioural change within the industry.

"*Let us remind ourselves what regulation is actually there for. It is to drive different behaviours. I have seen and have been part of other industries who have found themselves in similar positions, in the wake of a tragic or catastrophic event. The difference is that they have chosen to come together to demonstrate collective leadership and responsible behaviour, to be part of the solution, rather than continuing to be perceived as the problem.*"

Built environment governance and professionalism: the end of *laissez-faire* (again)

SIMON FOXELL

ABSTRACT

The regulation of the built environment depends upon a combination of governmental regulation, robust professional practice and market forces. The balance between these varies over time and different jurisdictions. This essay considers the recurrent rise and fall of the principle of *laissez-faire*. The growth and public purpose objectives of the professional institutions are examined, as is their decline under the ascendency of neoliberalism in the UK, though the analysis is relevant to other countries. A reconsideration of professional attitudes and attitudes to the professions resulting from the catastrophic fire in the UK's Grenfell Tower residential block in 2017 is currently underway. A return to the founding objectives of the institutions is recommended if they are to equip themselves with renewed purpose and to avoid over-restrictive regulation by government. Any such renewal needs to include a focus on behaviour, ethics, competence, research-based evidence and, above all, a transformation in the governance of the professions.

POLICY RELEVANCE

The recent history and current public purpose obligations of governmental and non-governmental organisations are considered to ensure that built environment professionals under their jurisdiction have the competence, authority and freedom of action to make reasonably certain that those obligations are fulfilled effectively. An approach to appropriate organisational governance and policy following several high-profile building failures, including the Grenfell Tower fire, as well as future environmental challenges, is described and discussed. A coordinated system of governance involving both market regulation and professionalism (guided by robust institutions) have an essential role to play in making an equitable and rules-based economy work and delivering both short- and long-term objectives.

BUILDINGS & CITIES

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KEYWORDS:
built environment; professionalism; professional institutes; governance; duty of care; caring; accountability; competence; UK

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SOURCES: https://www.thefpa.co.uk/news/dame-judith-hackitt-frustrated-by-lack-of-construction-industry-progress *and* https://doi.org/10.5334/bc.713

BREAK

www.usablebuildings.co.uk

Oxford Brookes University
5 November 2025

INSIGHTS FROM BUILDING PERFORMANCE EVALUATION STUDIES

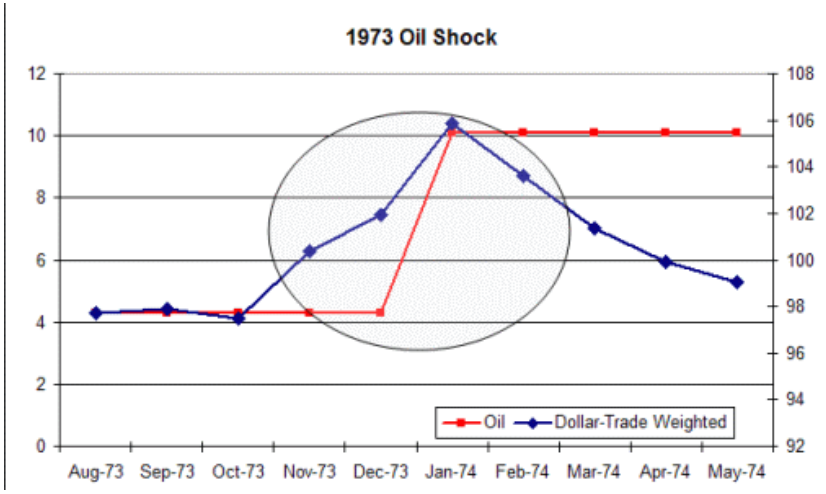
PART 2

Some findings and their implications

Bill Bordass

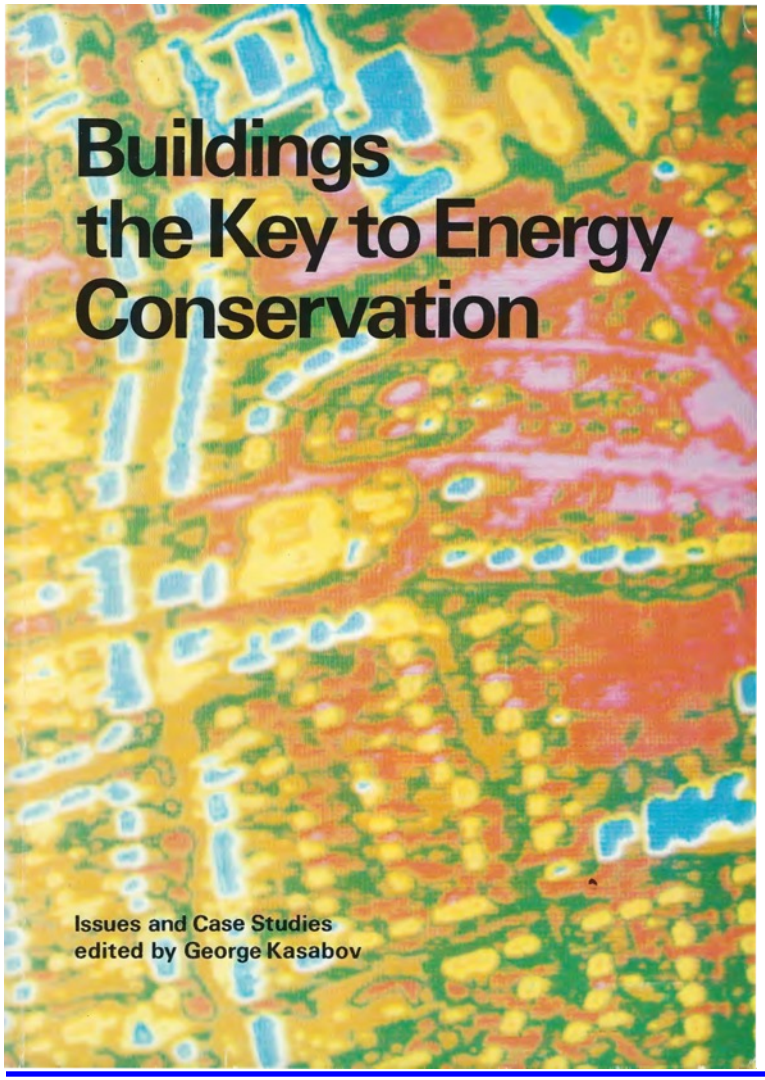
USABLE BUILDINGS
www.usablebuildings.co.uk

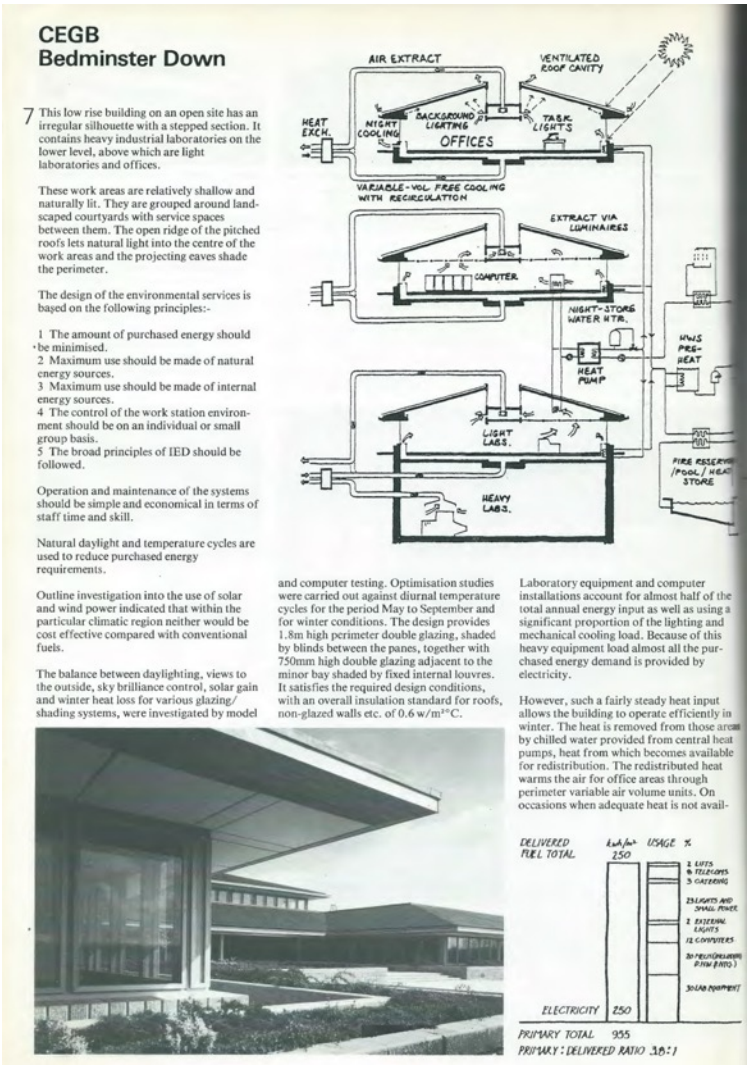
At the end of 1973, we had the oil crisis



In 1974, coal supplies also ran short in the UK, through trade union action, bringing on the 3-day week and bringing down the Tory Government …

RIBA Energy Group 1979 – *8 papers on issues, 50 Case Studies of low-energy buildings, with data*





CEGB
Bedminster Down

7 This low rise building on an open site has an irregular silhouette with a stepped section. It contains heavy industrial laboratories on the lower level, above which are light laboratories and offices.

These work areas are relatively shallow and naturally lit. They are grouped around landscaped courtyards with service spaces between them. The open ridge of the pitched roofs lets natural light into the centre of the work areas and the projecting eaves shade the perimeter.

The design of the environmental services is based on the following principles:-

1 The amount of purchased energy should be minimised.
2 Maximum use should be made of natural energy sources.
3 Maximum use should be made of internal energy sources.
4 The control of the work station environment should be on an individual or small group basis.
5 The broad principles of IED should be followed.

Operation and maintenance of the systems should be simple and economical in terms of staff time and skill.

Natural daylight and temperature cycles are used to reduce purchased energy requirements.

Outline investigation into the use of solar and wind power indicated that within the particular climatic region neither would be cost effective compared with conventional fuels.

The balance between daylighting, views to the outside, sky brilliance control, solar gain and winter heat loss for various glazing/shading systems, were investigated by model and computer testing. Optimisation studies were carried out against diurnal temperature cycles for the period May to September and for winter conditions. The design provides 1.8m high perimeter double glazing, shaded by blinds between the panes, together with 750mm high double glazing adjacent to the minor bay shaded by fixed internal louvres. It satisfies the required design conditions, with an overall insulation standard for roofs, non-glazed walls etc. of 0.6 w/m²°C.

Laboratory equipment and computer installations account for almost half of the total annual energy input as well as using a significant proportion of the lighting and mechanical cooling load. Because of this heavy equipment load almost all the purchased energy demand is provided by electricity.

However, such a fairly steady heat input allows the building to operate efficiently in winter. The heat is removed from those areas by chilled water provided from central heat pumps, heat from which becomes available for redistribution. The redistributed heat warms the air for office areas through perimeter variable air volume units. On occasions when adequate heat is not avail-

SOURCE: G Kasabov (ed), *Buildings, the Key to Energy Conservation,* RIBA Energy Group, 1979, 96 pages.

As did building-related ill-health

The WHO recognised Sick Building Syndrome in 1982

Also identified as Tight Building Syndrome in the USA

Source of diagram optipura.com

but 10 years later, in 1990 …

Tales of the unexpected

Office buildings claimed to be energy efficient, in reality often fall short of their quoted performance because of simple calculation errors and unknown energy-consuming extras. Matthew Coomber *reports.*

BUILDING owners beware – your energy-efficient building may not be as efficient as you have been led to believe.

Bill Bordass, an independent energy consultant and something of a guru in the field of energy efficient design, claims many offices are touted as energy efficient, but turn out not to be on closer examination.

He is helping to prepare a series of case studies of energy use in offices as part of the Energy Efficiency Office's Best Practice programme.

The studies detail energy usage and cost figures for each energy consumption elements missing or had recorded building areas much larger than that actually serviced," he says.

Errors in calculation had arisen either through mismeasurement of floor area or a failure to understand what constitutes the treated area, that is, the area of a building that consumes energy, in whatever form.

"We found that energy researchers have a tendency to look in great detail at where the energy goes, but will often ask somebody else for a building area." Usually rounded up or

Bordass says some people measure energy consumption by the whole building, some by building services only, and some by landlord's building services only. "This can produce great discrepancies when you come to measure the floor area and the devices properly," Bordass notes.

In addition, tenants can be confused about who pays for services, resulting in the doubling-up or omission of important elements of the energy bill.

The next problem concerns the assumptions that the people

SOURCE: M Coomber, *Tales of the Unexpected,* Building Magazine 38-39 (17 August 1990).

ELSEVIER

… and in the USA

Energy and Buildings 21 (1994) 121–131

ENERGY AND BUILDINGS

Two-to-one discrepancy between measured and predicted performance of a 'low-energy' office building: insights from a reconciliation based on the DOE-2 model

L.K. Norford, R.H. Socolow, E.S. Hsieh, G.V. Spadaro[1]

Center for Energy and Environmental Studies, Princeton University, Princeton, NJ, USA

Received 1 February 1989; accepted in revised form 25 April 1994

Abstract

Computer models of building energy use, if calibrated with measured data, offer a means of assessing retrofit savings, optimizing HVAC operation (on- or off-line), and presenting energy-consumption feedback to building operators. The calibration process itself can pinpoint differences between how a building was designed to perform and how it is actually functioning. Our initial goal was to identify why the actual annual energy consumption of an office building was 325 kWh/m^2, over twice the predicted value of 125 kWh/m^2. Part of our effort to understand its performance involved calibrating a DOE-2 model prepared at the design stage. In the process, we formulated calibration guidelines and developed insights that may be of use to others. Of particular interest are the major sources of the wide discrepancy between predicted and actual energy use. Unanticipated tenant energy consumption, both during the day and the night, contributed 64% of the two-fold increase. Heating, ventilation and air-conditioning (HVAC) equipment operation beyond the expected 10 h per weekday contributed 24%. We attributed the remaining 12% to HVAC equipment not operating up to specification; building conductive heat loss in excess of the design-stage prediction; and minimum outdoor-air intake differing from the design value. The calibration process involved working on major input parameters independently of the others, then combining the results into one simulation. The calibrated model accounted for 94% of measured site energy for the building.

… and in Australia, *though its NABERS system has improved things, starting in rented offices*

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.

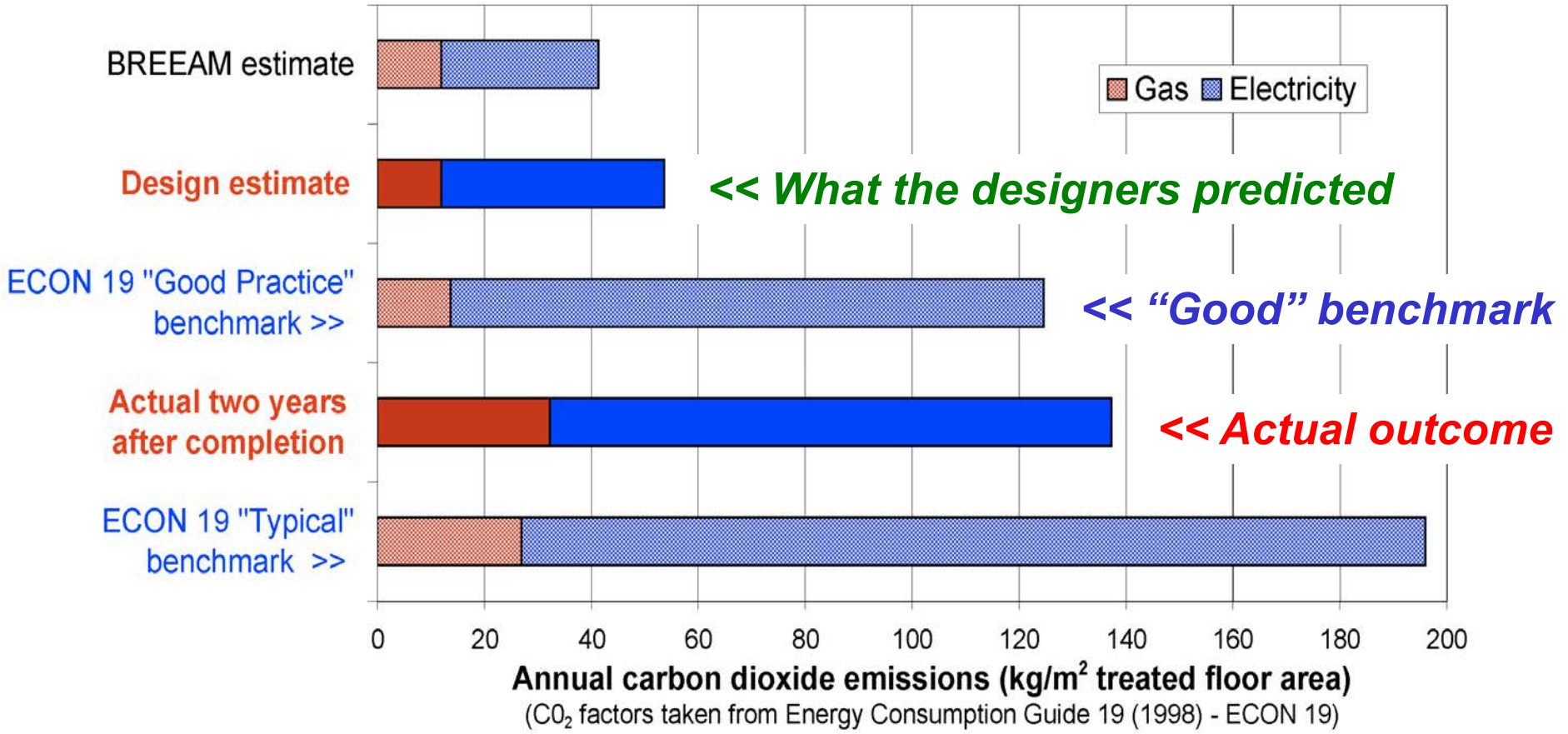
While some argue that good design is all, those involved in operating buildings are generally aware that the issues of delivering and operating high-efficiency buildings are somewhat more complex. A building that has a good theoretical performance may not perform well in practice, while many lesser buildings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

BREEAM for offices was introduced in 1990, *but performance gaps persisted…*

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).

BPE as real-world research
(after Robson, 1993)

Solving problems **NOT** Just gaining knowledge

Predicting effects **NOT** Just finding causes

Robust results, actionable factors **NOT** Only statistical relationships

Developing & testing services **NOT** Developing & testing theories

Field **NOT** Laboratory

Outside organisation **NOT** Research institution

Strict time and cost constraints **NOT** R&D environment

Researchers with wide-ranging skills **NOT** Highly specific skills

Multiple methods **NOT** Single method

Oriented to client **NOT** Oriented to academic peers

Viewed as dubious by some academics **NOT** High academic prestige

Large samples are not necessary, if you understand the context.

Case studies of individual buildings tell stories

and can establish hypotheses that can be tested elsewhere.

SOURCE: After H Robson, *Real-World Research* (Butterworth-Heinemann, 1993), 5th Edition (2023).

Published POEs using simplified multiple methods:

Some things we found in the twenty Probe studies 1995-2002

- New buildings 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 not communicated well through the process; and designers and builders go away at handover.
- Unmanageable complication: **the enemy of good performance**.
- Buildings are seldom tuned-up and controls are a muddle. So why are we making things complicated?
- Modern procurement systems make it difficult to pay attention to critical detail. ***A bad idea when promoting innovation.***

"The English spare no expense to get something on the cheap". ***… NIKOLAUS PEVSNER***

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

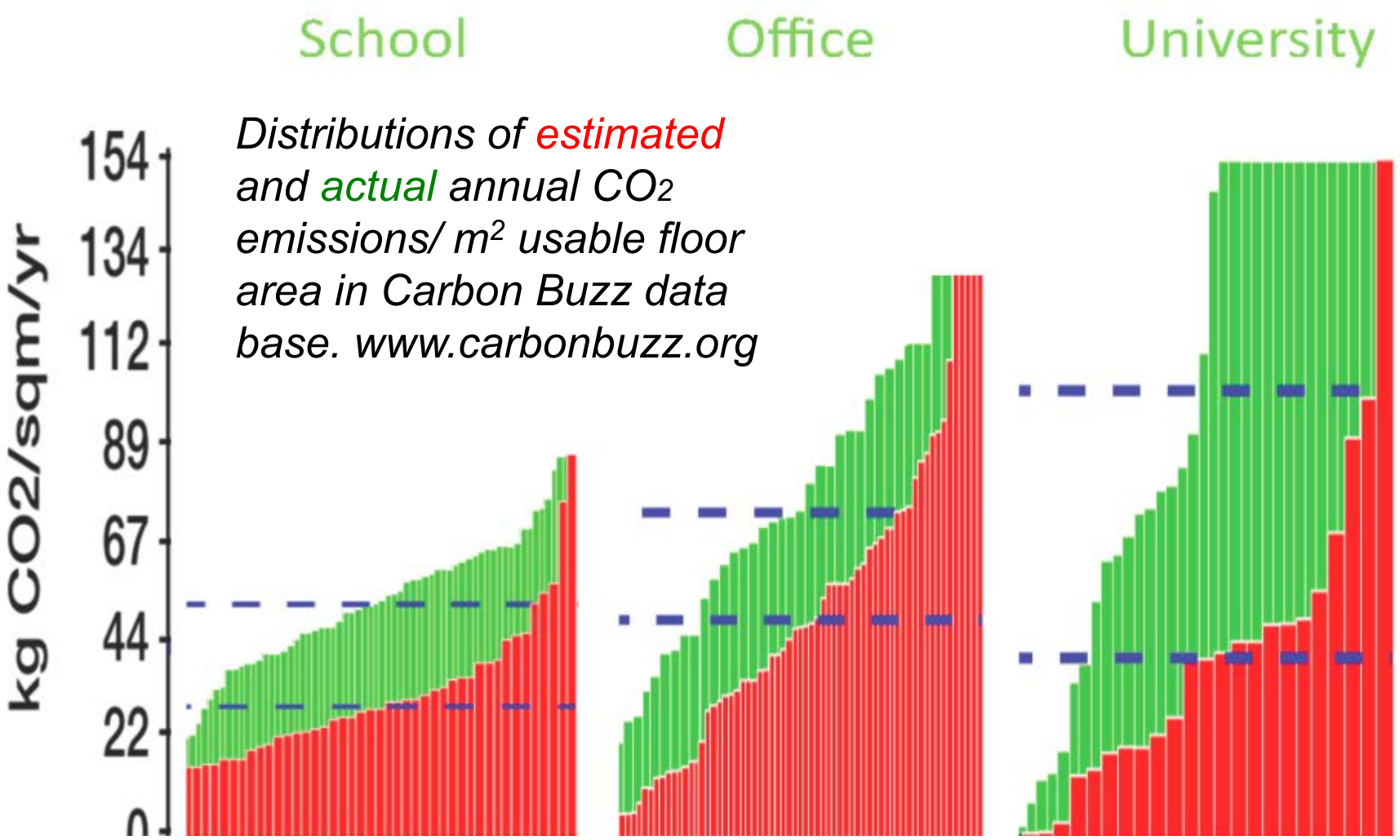
New non-domestic buildings:

Some strategic implications of the Probe POE findings

- 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 not communicated well through the process. **SO … *Understand how buildings work in use, follow through after handover, and learn from the experience.***
- **Unmanageable complication: the enemy of good performance**. **SO … *Stop making buildings complicated in the name of sustainability and get the simple things right.***
- Buildings are seldom tuned-up and controls are a muddle. **SO** … ***Design to enhance usability and manageability.***
- Modern procurement systems make it difficult to pay attention to critical detail. **SO** … ***Change the processes.***
- **AND THEREFORE**… **Focus on in-use performance, communicate it clearly and manage it properly.**

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

Evidence of performance gaps in the UK is now overwhelming; *in many other countries too.*



SOURCE: Ian Taylor and Judit Kimpian, *Carbon Buzz Launch slides,* 6 June 2013. www.carbonbuzz.org

The gaps occur in new housing too:
a full 40 years after the 1973 oil crisis

Minister launches Hub-led project
performance challenge **Ecobuild**

A new project to examine the energy performance of new homes is unveiled today. The industry-backed project brings together leading housebuilders and industry experts to investigate the actual performance of homes and better understand how this compares to that expected by the original design. Communities and Local Government minister Rt Hon Don Foster MP announced a new £380,000 grant for

CLOSING THE GAP BETWEEN

DESIGN

&

AS-BUILT PERFORMANCE

END OF TERM REPORT

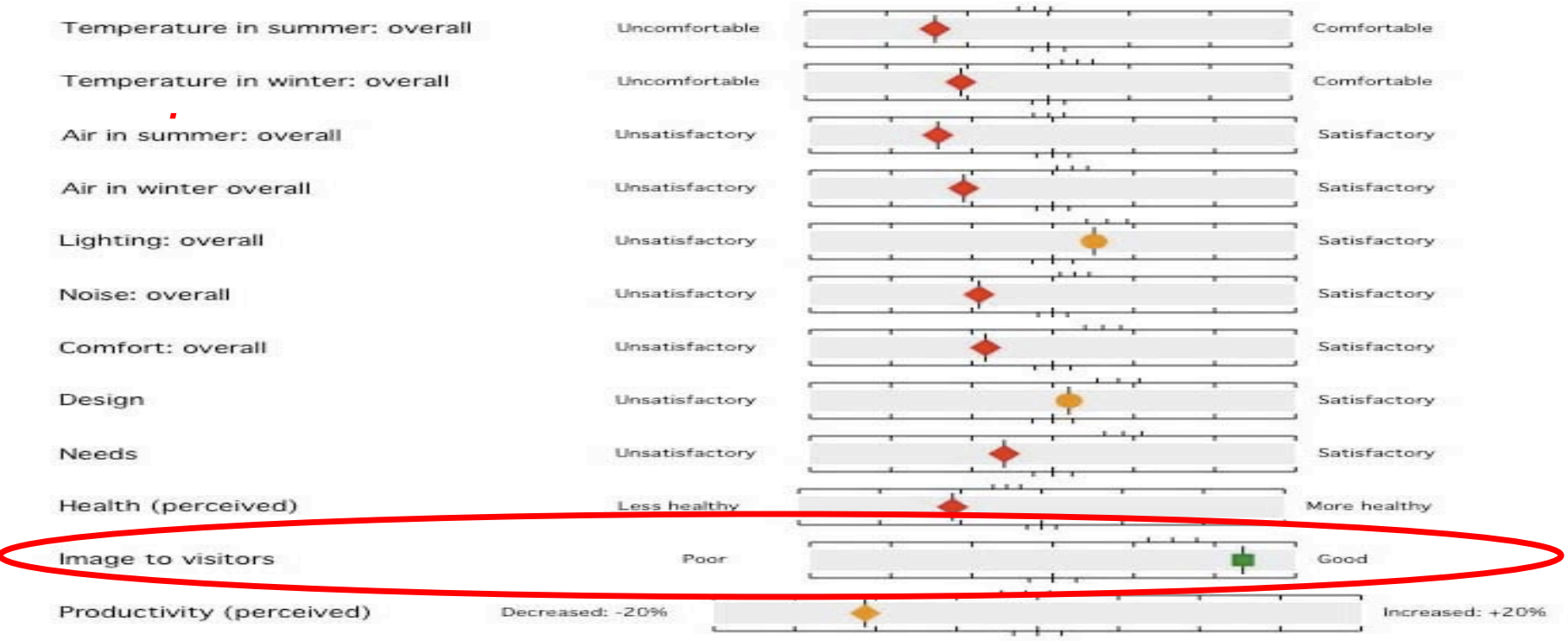
July 2014

ZERO CARBON HUB

Zero Carbon Hub, *Closing the gap between design and as-built performance* (July 2014)

Performance gaps are not just for energy:
occupant survey, multi-award-winning school

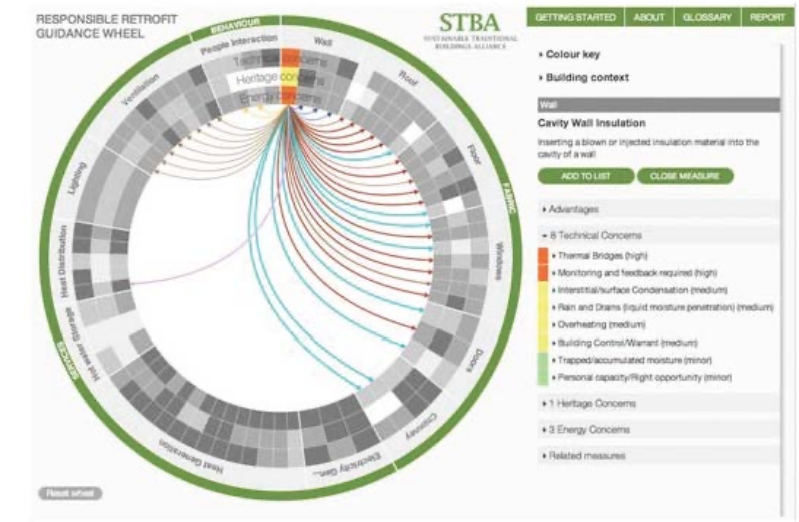
RED: below average; AMBER: Average; GREEN: Above average



" … the architecture showed next to no sense. It leaked in the rain and was intolerably hot in sunlight. Pretty perhaps, sustainable maybe, but practical it is not." … STUDENT

SOURCE: BUS Method survey of a building services engineering award-winning Academy school in South East England, 2009

The gaps are not just for new buildings:
Knowledge base for retrofit



SOME CONCLUSIONS

Industry and policy lack understanding of traditional building performance.

Lack of connection between research intelligence and guidance procedures.

Significant uncertainty in application of models and software.

Some methods used are inappropriate.

A systemic approach is necessary to avoid unintended consequences.

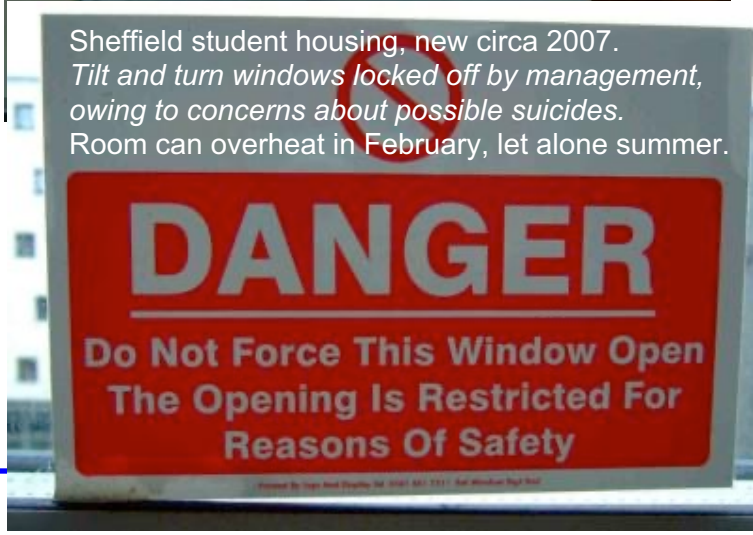
There are good opportunities, but some will need to be developed using a rather different basis and structure.

SOURCES: Report (Sept 2012) downloadable from www.stbauk.org Guidance Wheel at www.responsible-retrofit.org/wheel

Simple dysfunctions in recent buildings:
Poor window design, leading to overheating

Cambridge sheltered housing, opened 2011. *No secure, fine control ventilation available: could easily have been small windows in the panel between the doors. Doors need two hands to operate: not clever if you have arthritis!*

Sheffield student housing, new circa 2007.
Tilt and turn windows locked off by management, owing to concerns about possible suicides.
Room can overheat in February, let alone summer.



… and widely dysfunctional controls

BCIA
Building Controls Industry Association

Controls for End Users

Usability criteria	Ranking (controller as supplied) Poor – Excellent
Clarity of purpose	●
Intuitive switching	●
Labelling and annotation	●
Ease of use	▬
Indication of system response	▬▬
Degree of fine control	●

This control for lighting has clear switching with four settings clearly illuminated, plus an off setting. The numbers by the setting are arbitrary.

Apart from the numbering, the switch is not labelled as to what it does. The red light for setting 1 is on the far left of its button, hinting that there be more than one stage for each setting. Is the off button for system off, or does it apply to each of the four stages in turn? Does the vertical button to the right raise or lower the lighting generally, or on each setting? In the absence of clear annotation, the user is forced to experiment.

Usability criteria	Ranking (controller as supplied) Poor – Excellent
Clarity of purpose	▬
Intuitive switching	▬
Labelling and annotation	▬
Ease of use	▬▬
Indication of system response	●
Degree of fine control	▬

This controller is clearly a control device for ventilation. The knob at the lower left appears to offer control over a setpoint (presumably for temperature), against an arbitrary scale of plus or minus. In the absence of controller feedback, the user would need to learn the settings by experimentation. The function of the knob on the right is clearer, with three fan speed-settings, but is it for room ventilation or a fan in a heating/cooling unit? Probably the latter, as experience has forced the facilities manager to append a label telling users not to switch off the fan.

"we sell dreams and install nightmares"
– CONTROLS SUPPLIER

SOURCE: www.usablebuildings.co.uk/Pages/Publications/UBPubsControlsForEndUsers.html and BSRIA

Massive discrepancies can go unrecognised

Wasteful overprovision in new buildings:
A “low energy” office’s staff kitchen - *with kettle, microwave and vending, where 300 lux would do.*

Technology - management interactions:

Conclusions from the Probe POE studies of public and commercial buildings. Confirmed by later work

		Technological complexity	
		More	**Less**
Building management input	**More**	*Type A* Effective, but often costly	*Type D* Rare, not replicable?
	Less	Risky with performance penalties *Type C*	Effective, but often small-scale *Type B*

Diagram first appeared in: *Probe 19: Designer Feedback,* Building Services, the CIBSE Journal, page E21 (March 1999).

Technology - management interactions:

Conclusions from the Probe POE studies of public and commercial buildings. Confirmed by later work

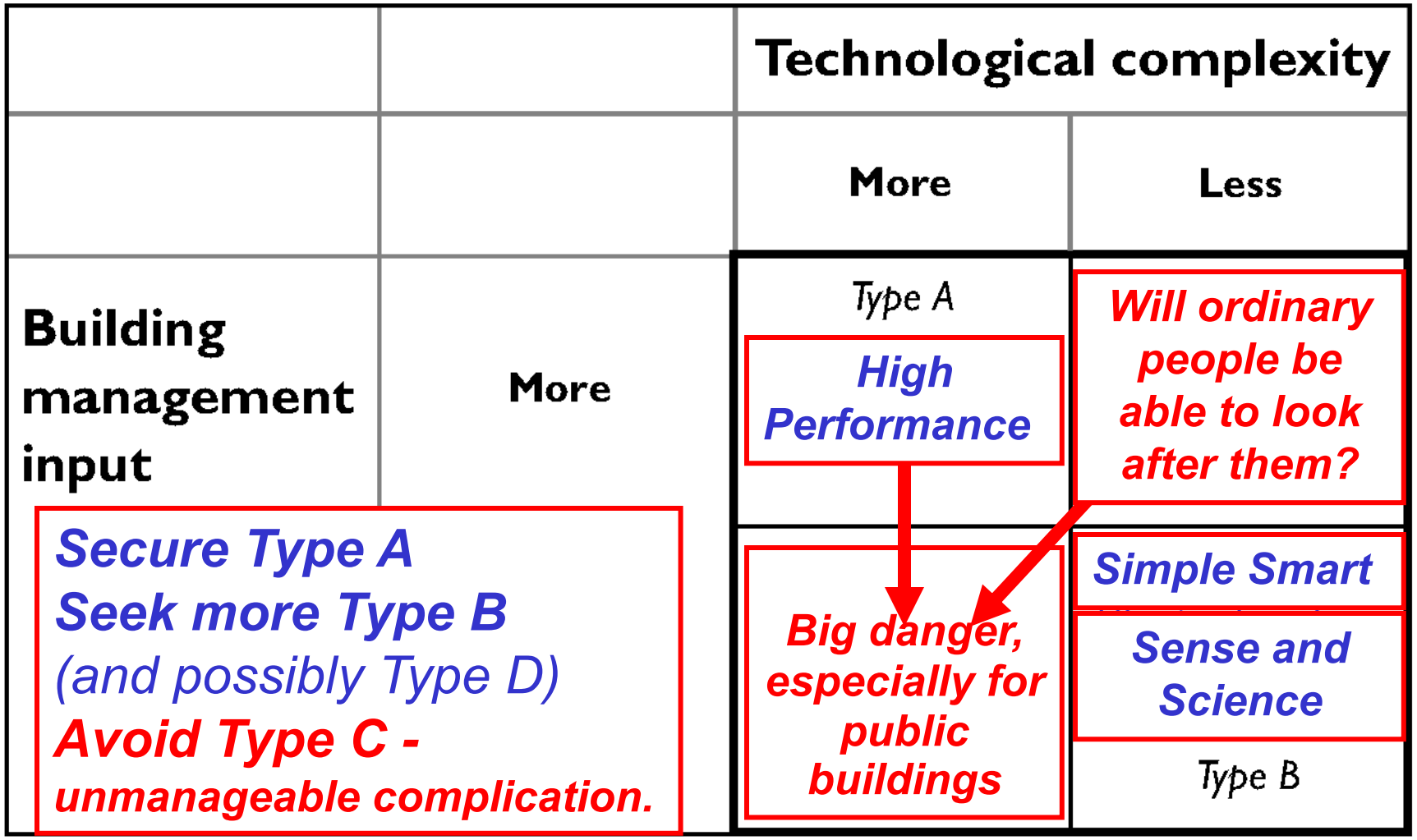


Diagram first appeared in: *Probe 19: Designer Feedback,* Building Services, the CIBSE Journal, page E21 (March 1999).

Probe conclusions: *Less can DO more*

INTERVIEW

09

Architect Rab Bennetts and Usable Buildings consultant Bill Bordass put forward a modest proposal for sustainable design

'Keep it simple and do it well'

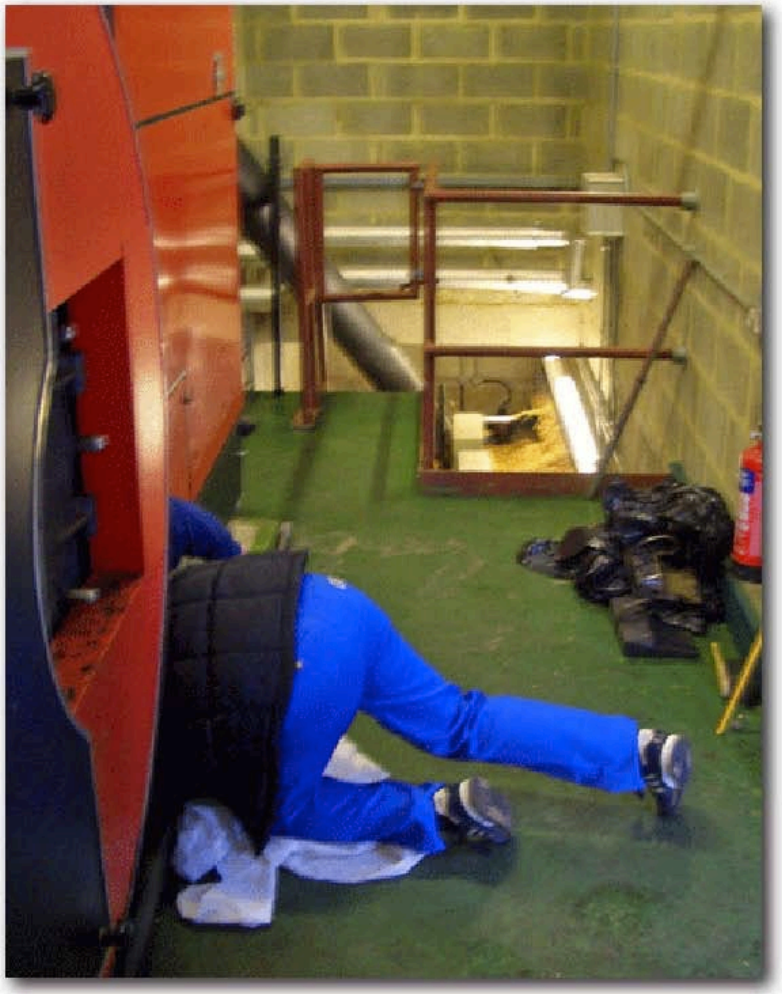
SOURCE: R Bennetts and W Bordass, Building Magazine Sustainability Supplement 8-11 (28 Sep 2007)

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

Don’t procure
what you can’t afford to manage



In spite of these insights from the 1990s, *complication has burgeoned this century*

- Technical complication
- Legislative complication
- Contractual complication
- Bureaucratic complication
- Tick-box procedures: feature creep
- Complication for building users and managers

So less money to spend on basics

And the complication disease has spread to housing too!

NOTHING JOINS UP PROPERLY!

"Complexity is profitable, [it] makes people believe you understand it."
JON DANIELSSON

F Stevenson et al,: *The usability of control interfaces in low-carbon housing,* Architectural Science Review, 1-13 (2013).

Examples of unmanageable complication in domestic buildings …

SIGMA HOUSE, BRE *(illustrated)*

- Extensive feedback from occupants, including comfort, ergonomics, space.
- Complicated, confusing and unreliable technologies and renewables.
- Energy use much higher than predicted.

ELMSWELL, ORWELL

- Two-thirds of residents could not programme their thermostats.
- Mechanical ventilation with heat recovery was present, but 95% of people had windows open in winter.
- Design air change was 0.5 to 1 ac/h. One open window could provide 17 ac/h!

SOURCE: Sigma monitoring by Oxford Brookes University, Elmswell by Buro Happold in KTP with Bristol University.

So Yet Again ... *Some conclusions from TSB-IUK Building Performance Evaluation programme 2010-14*

Significant problems with integrating new technologies,
especially configuring and optimising BMSs.
Insufficient thought given to how occupants will use them.

"Controls are something of a minefield."
Tendency to make control of heating, lighting and renewable energy systems over-complicated. The one air source heat pump had operational issues in cold weather.

Problems with automatic window controls.

Multiple systems fighting each other *e.g.* cooling vs heating, different heating systems jockeying for control.

Maintenance, control & metering problems,
especially with biomass boilers, PVs and solar heating.

SOURCE: J Palmer & P Armitage, BPE Programme, Early findings from non-domestic projects, Innovate UK (Nov 2014)

HALF A CENTURY AFTER THE 1973-74 OIL CRISIS

… *and now in our* ***CLIMATE and ENVIRONMENT EMERGENCY***

In spite of very recent developments, many designers still don't have much of a clue about how buildings use energy, or indeed perform in many respects, and what really needs doing about it.

THIS IS A SCANDAL !

BREAK

www.usablebuildings.co.uk

Oxford Brookes University
5 November 2025

INSIGHTS FROM BUILDING PERFORMANCE EVALUATION STUDIES

PART 3
A possible future

Bill Bordass

USABLE BUILDINGS
www.usablebuildings.co.uk

"The house is on fire"
… GRETA THUNBERG

- We must save energy and carbon in a hurry *embodied not just operational …* and remember.
- this is but a small – *but essential* - part of what we need to do to improve the environment.
- We need more thinking and less stuff; and
- to make much better use of what we already have.

Much of what we have got used to,
we're not necessarily entitled to.

If you wanted to improve building performance in use, *what would you do …*

A. Focus on building performance in use?

OR

B. Do lots of other things and hope that performance will improve …?

Why have we been barking up the wrong tree?

Why has actual performance not been the target?

A glimmer of hope: Stage M came back!
as Stage 7 in the RIBA Plan of Work 2013 and 2020

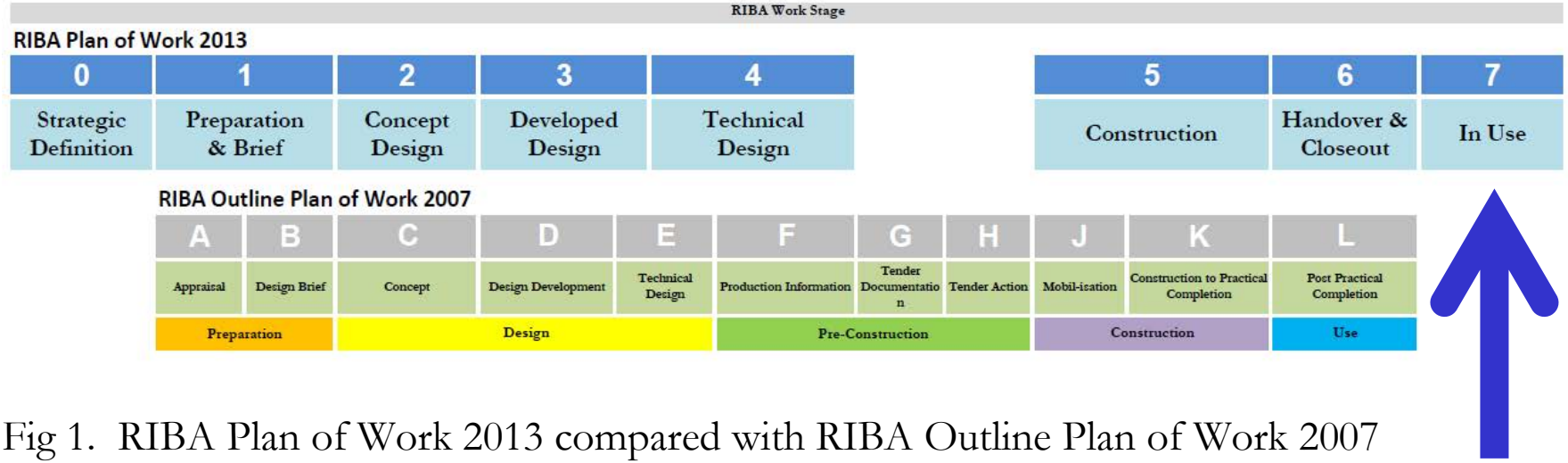


Fig 1. RIBA Plan of Work 2013 compared with RIBA Outline Plan of Work 2007

And of course some universities are becoming more active - with Oxford Brookes one of the leaders .

But most design professionals *(particularly those in the larger firms)* still get very little exposure to how their buildings actually work.

SOURCE: RIBA Plan of Work overview (March 2013). See also www.architecture.com/planofwork

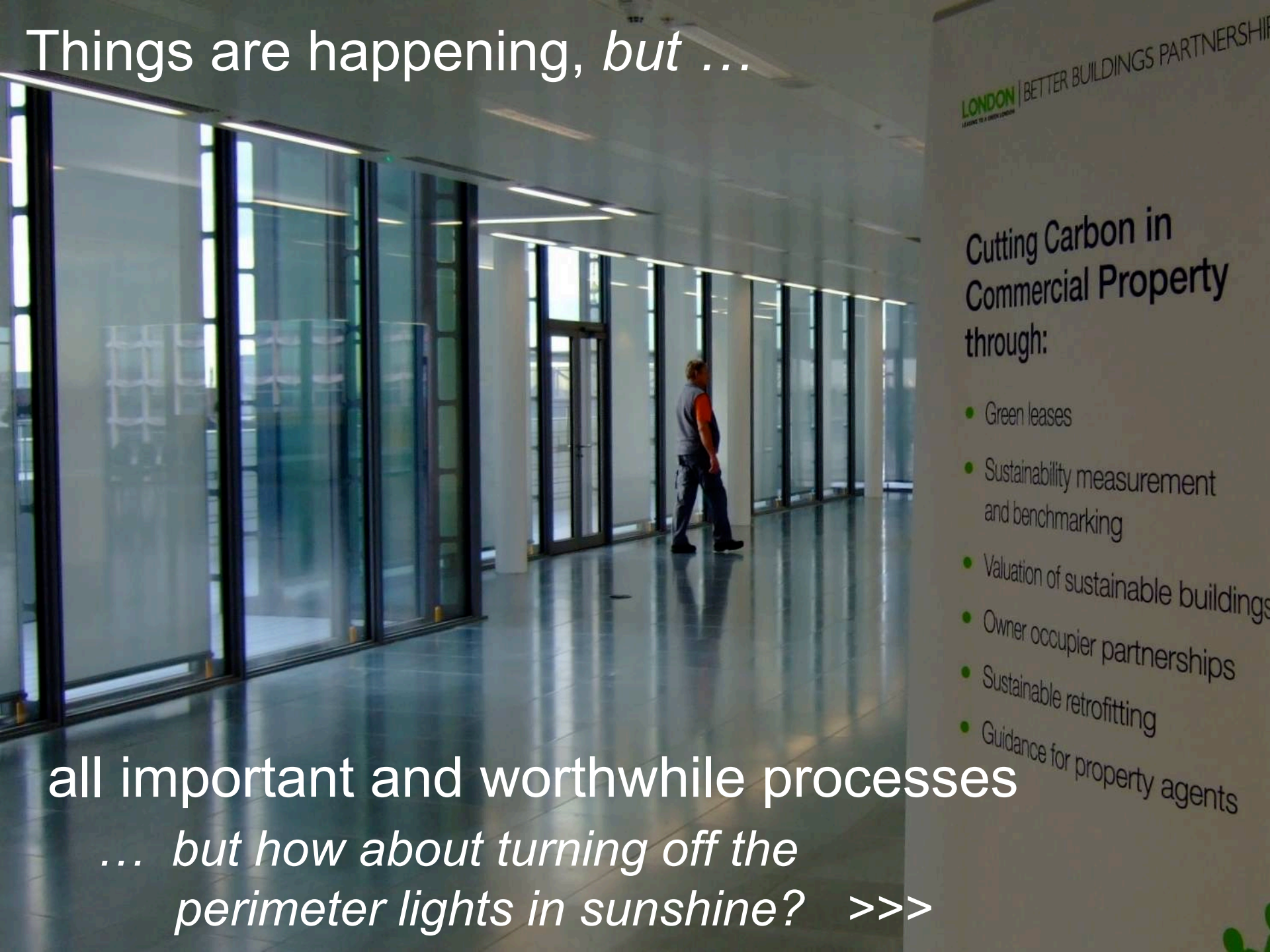
Changing the way we do things

- Many construction-related institutions require their members to understand and practice sustainable development.
- How can members do this unless they understand the consequences of their actions? *The real outcomes.*
- If they don't, they are working outside their region of competence …
- **or in other words, not acting in a fit manner for a professional !**

SO HOW ABOUT?

- Changing attitudes to the nature of the job.
- Re-defining perceptions of the professional's role, to follow-through properly and to engage with outcomes.
- Closing the feedback loop – rapidly and efficiently.
- Making much more immediate, direct and effective links between research, practice and policymaking.

Things are happening, *but …*



all important and worthwhile processes

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

Our proposed sticky interventions:
seeding things with potential to snowball over time

Cultural adaptations, not just technical "solutions".
To create virtuous circles of continuous improvement.

MAKE IN-USE PERFORMANCE CLEARLY VISIBLE
In a way that motivates people to strive to improve it.
This needs a well-informed technical infrastructure to help the plethora of different systems to converge, particularly for energy and carbon.

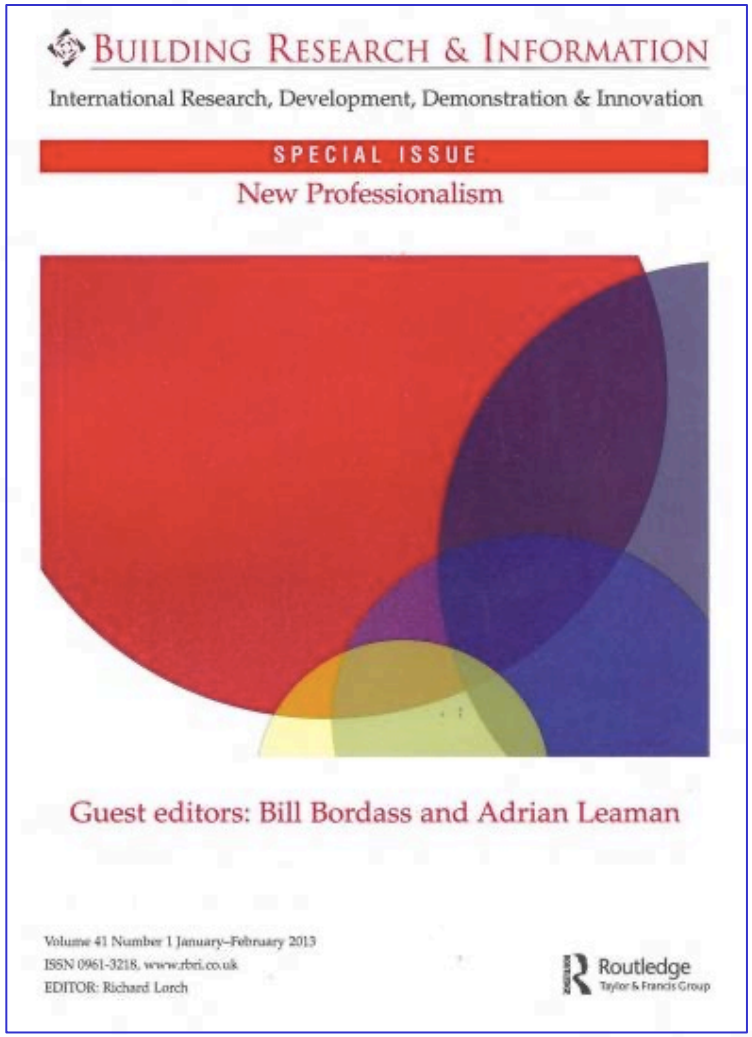
CONSOLIDATE THE KNOWLEDGE DOMAIN
Develop building performance as an independent knowledge domain, to gain the evidence and authority to inform practice and policymaking.

REVIEW PROFESSIONAL ETHICS AND PRACTICES
A shared vision for building-related professionals to work in the public interest and engage properly with outcomes: *NEW PROFESSIONALISM*

SEE ALSO: Bill Bordass, George Henderson Memorial Lecture, University College London (12 June 2013).

New Professionalism: getting started

Principles anyone can adopt tomorrow



PROVISIONAL LIST DEVELOPED WITH THE EDGE

ETHICS AND CONDUCT:

1. Be a steward of the community, its resources, and the planet. Take a broad view.
2. Do the right thing, beyond your obligation to whoever pays your fee.
3. Develop trusting relationships, with open and honest collaboration.

ENGAGEMENT WITH OUTCOMES:

4. Bridge between design, project implementation, and use. Concentrate on the outcomes.
5. Don't walk away.
   Provide follow-through and aftercare.
6. Evaluate and reflect upon the performance in use of your work. Feed back the findings.
7. Learn from your actions and admit your mistakes. Share your understanding openly.

THE WIDER CONTEXT:

8. Seek to bring together practice, industry, education, research and policymaking.
9. Challenge assumptions and standards. Be honest about what you don't know.
10. Understand contexts and constraints. Create lasting value. Keep options open for the future.

SOURCE: The Editorial of BR&I **41**(1), Jan-Feb 2013 can be downloaded at www.tandfonline.com/toc/rbri20/41/1

New Professionalism: more recent progress

Morrell report for the Edge, second edition Jan 2020

The report focuses largely on the role of the institutions: ***Top Down***.

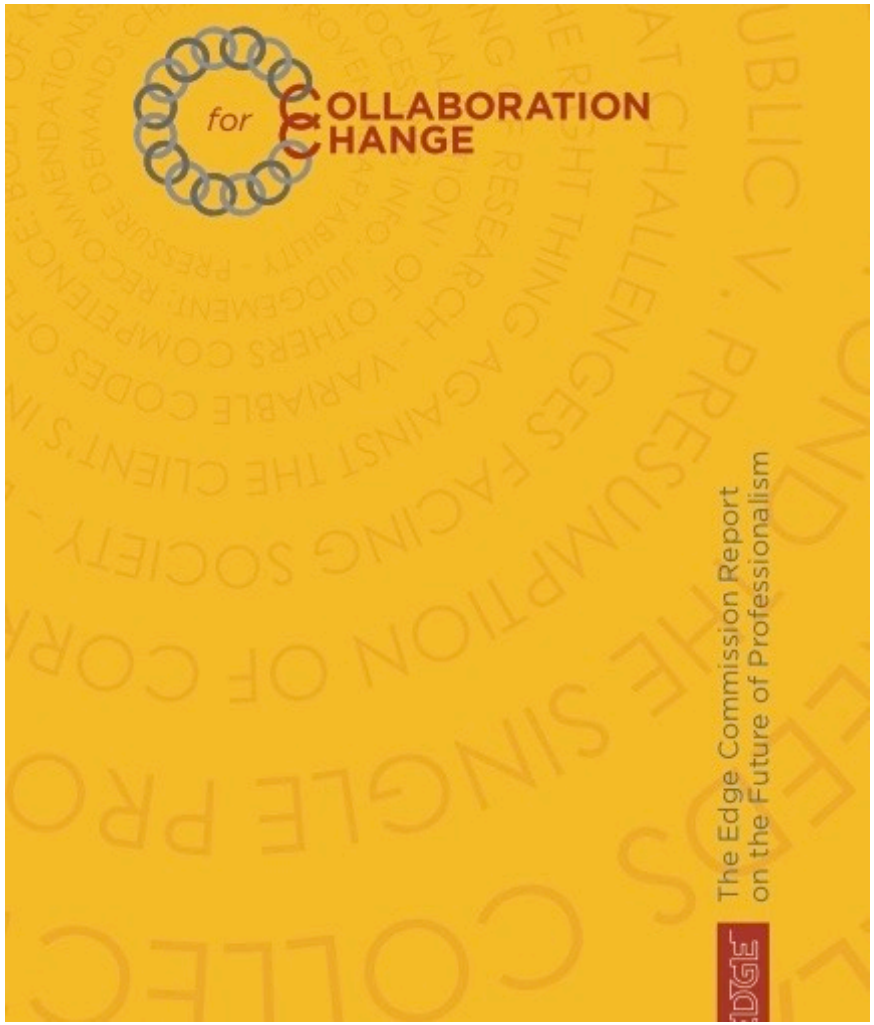
Key themes: *Ethics, Education, Knowledge, Collaboration.*

We also need two complementary approaches, to gather momentum:

Bottom-up*:*
The individual,
e.g. adopting the ten points.

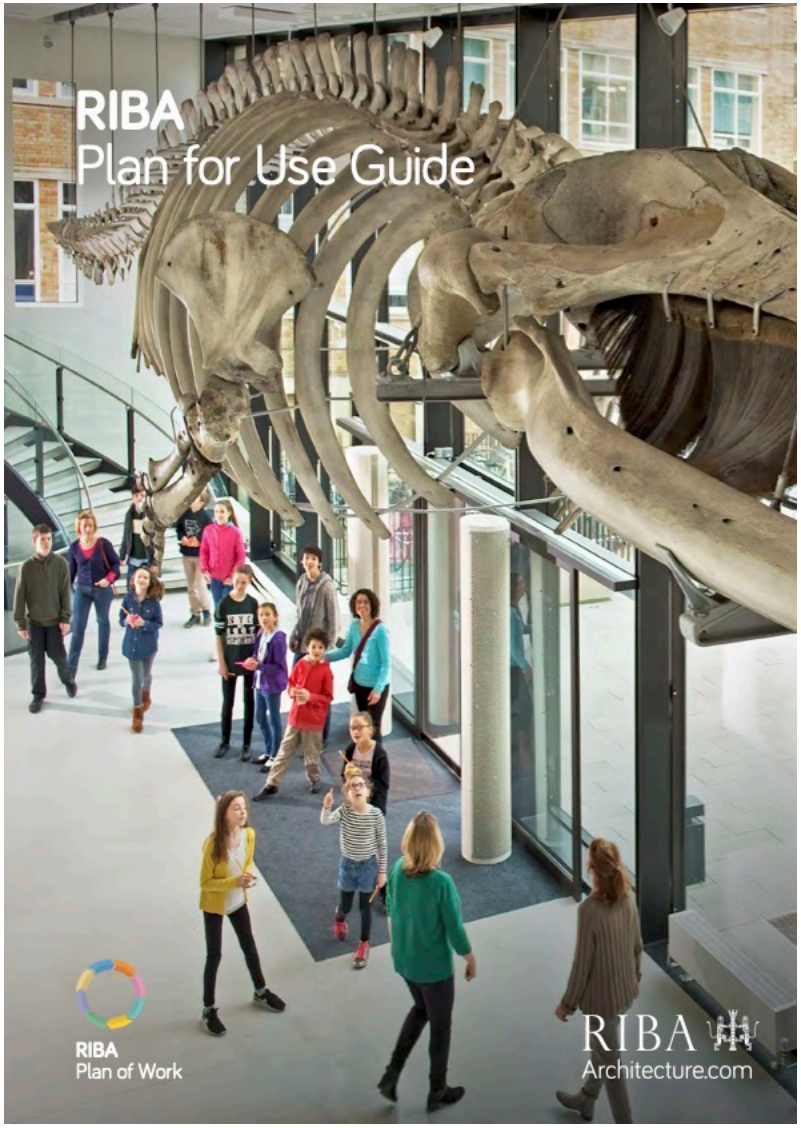
Middle-out:
At organisational and practice level.

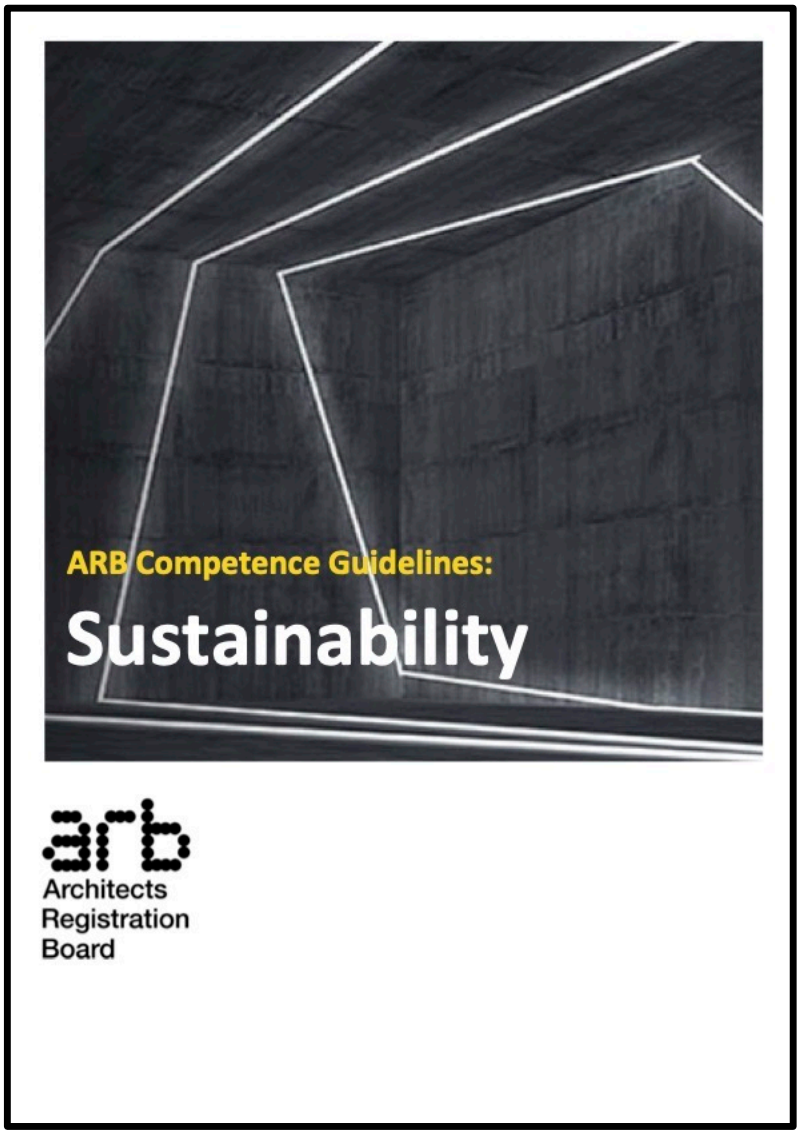
TIME FOR A HIPPOCRATIC OATH for ALL BUILDING PROFESSIONS?



SOURCE: https://static1.squarespace.com/static/5cc0112bb91449446cbd2a16/t/5ecf983501658b7cb875741e/1590663224573/CollaborationForChange_Book_Ed2-Final.pdf

Architectural response at last: *Apr+Aug 2021*





ARB – Architects Registration Board
Sustainability Competence Requirements 2021

A. ETHICS AND PROFESSIONALISM:
SA1. Climate science; SA2. Resilience, mitigation, adaptation;
SA3. Sustainable regenerative solutions and ethical sourcing;
SA4. Maintain knowledge of key legislation; **SA5. Share building performance data**.

B. SUSTAINABLE DESIGN PRINCIPLES:
SB1. Relationships between buildings, settlements, communities, climate. Design LZC;
SB2. Social sustainability and value; SB3. Biodiversity, access to green infrastructure;
SB4. • Retrofit and Fabric First • Passive Design • Daylight • Renewables • LCA and LCC • WLC and Low embodied carbon design • Water cycle, demand, supply, and reduction.

C. ENVIRONMENTAL AND BUILDING PHYSICS.
SC1. Temperature, humidity, sound & light; SC2. Comfort, IAQ & energy; SC3. Calculate operational and embodied energy and carbon **SC4. Do POE/BPE and understand gaps.**

D. CONSTRUCTION TECHNOLOGY.
SD1. Embodied carbon: resource & **performance** implications; SD2. Airtightness, thermal integrity; **SD3. Performance of energy systems**; SD4. Circular economy principles.

SOURCE: arb.org.uk/wp-content/uploads/ARB-Competence-Guidelines_-Sustainability.pdf

Achieving projects that work better in use: ***Soft Landings*** *antecedent to RIBA* ***Plan for Use***

Augments the duties of the design and building team, *(and of client representatives),* especially:

- During the critical briefing stage.
- With closer forecasting of building performance.
- With greater involvement with users before and after handover, and on-site presence during settling-in; and
- including monitoring and review for the first 3 years of use.

Soft Landings can:

- *Be used on any project, in any country, with any procurement route.*
- *Provide a fast track to raising building performance.*
- *Help to provide more customer focus for the industry.*
- *Improve client relationships and user satisfaction.*
- *Build recognition that some debugging is to be expected.*

It is primarily about a change in attitude.
It needs champions to take it forward - The new professionals: YOU!

Soft Landings: providing the "golden thread"
Key findings from its application 2009-2022

STAGE 1 – INCEPTION AND BRIEFING

Client leadership is key.
Champions need to be designated.

STAGE 2 – DESIGN AND CONSTRUCTION

A question of **attitude** – no additional costs.
Regular reality-checking is essential.
Clients must not drift off – too often they do.

STAGE 3 – PREPARATION FOR HANDOVER

Dialogue with occupiers+operators **needs more care**.

STAGE 4 – INITIAL AFTERCARE *typically Year 1*

Difficult for **contractors** not to **revert to type**.
Helps to have a **client budget** for fixing things quickly.

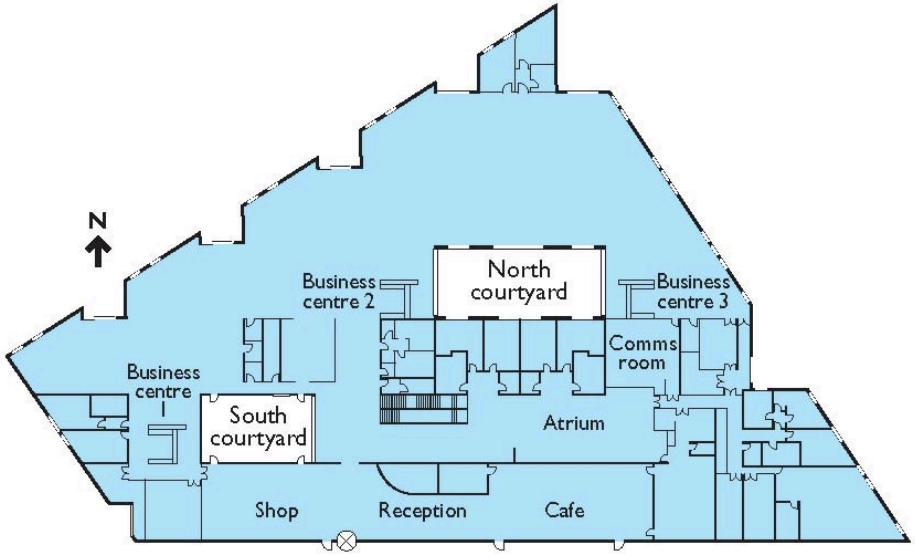
STAGE 5 – LONGER TERM AFTERCARE *Years 2+3*

Needs some **independent, disinterested input**.
Needs **funding outside the building contract**.

Published July 2009, minor revisions 2014, downloadable from www.usablebuidings.co.uk and www.softlandings.org.uk

BSRIA BG 4/2009

Pioneer example by research team members:
National Trust Heelis Building, Swindon



Scheme design by Feilden Clegg Bradley Studios (architects), Max Fordham (building services), Adams Kara Taylor (structural). Completed 2006.

Design intent to reality: *if expectations are not constantly reviewed, credibility gaps will 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 has drawn a veil over underlying 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 NEEDS MANAGING THROUGH THE PROCESS AND ON INTO USE

Managing expectations with Soft Landings:

Sustainability matrix approach used by the Heelis team

Sustainability Matrix: Offices **Feilden Clegg Bradley** Architects LLP ©

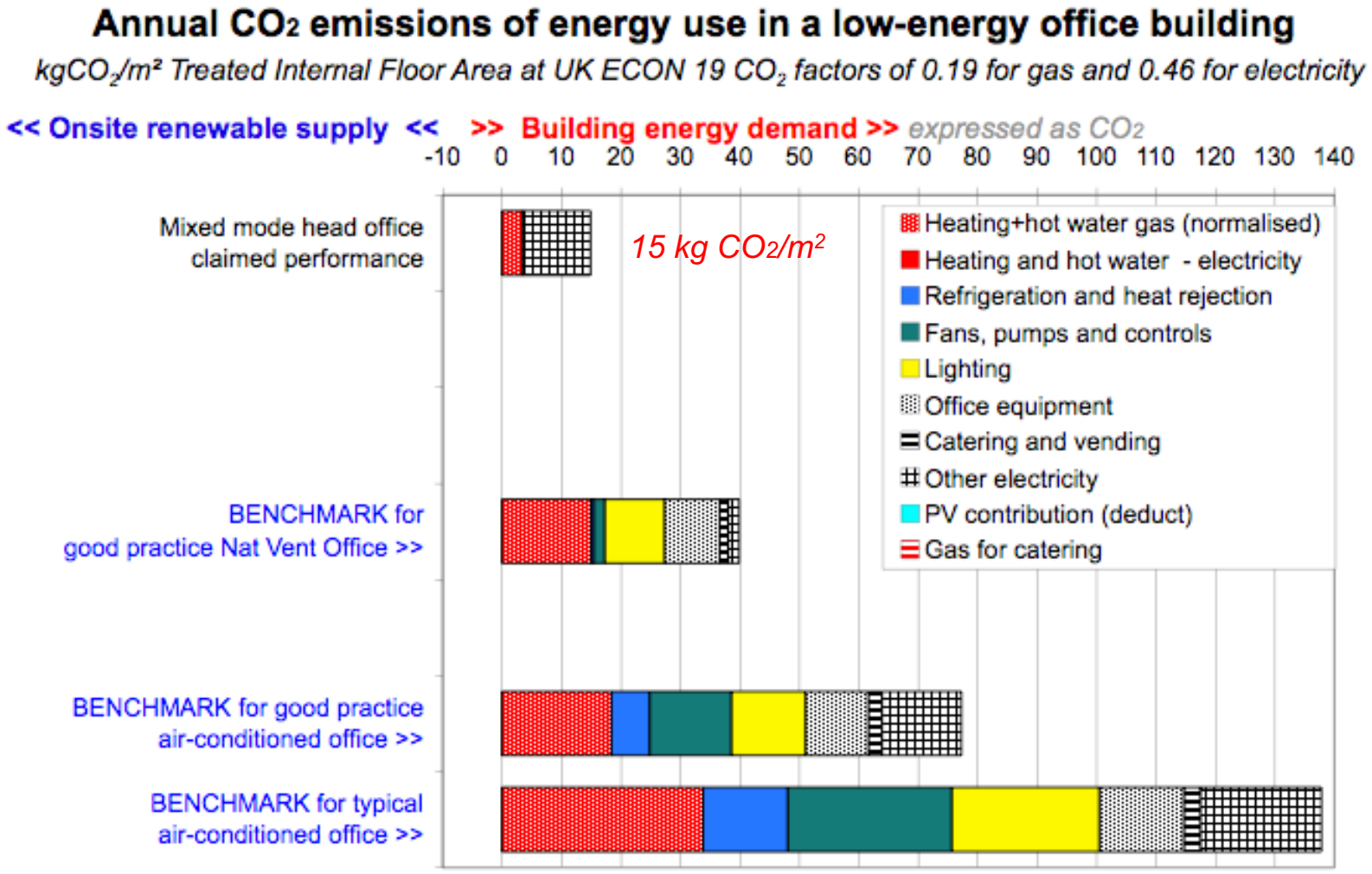
Operational Energy Consumption and CO^2 Emissions

	1. GOOD PRACTICE	2. BEST PRACTICE	3. INNOVATIVE	4. PIONEERING	NOTES
1. CO^2 Emission Target	40kgCO^2/m²/yr	30kgCO^2/m²/yr	15kgCO^2/m³/yr	"Carbon neutral" 0kgCO^2/m	Industry standard EEO targets
2. Heating Load Target	79kWhr/m²/yr	47kWhr/m²/yr	30kWhr/m²/yr	20kWhr/m²/yr	Industry standard EEO targets
3. Electrical Load Target	54kWhr/m²/yr	43kWhr/m²/yr	35kWhr/m²/yr	25kWhr/m²/yr	Industry standard EEO targets
4. U Values: Wall **Average Window** **Roof** **Ground Floor**	0.35 2.2 0.2 0.25	0.25 1.8 0.18 0.22	0.2 1.4 0.15 0.2	0.1 0.9 0.1 0.1	good practice=current building regulations pioneering=Bedzed values
5. Airtightness	<10m³/hr/m²	<8m³/hr/m²	<5m³/hr/m²	<3m³/hr/m²	All measures require careful attention to details and monitoring construction.
6. Ventilation	Natural ventilation where possible. Mechanical ventilation where not.	Designed natural ventilation with automatic openers, mechanical ventilation to WCs etc.	Mechanical ventilation with heat reclaim in winter and BMS controlled natural ventilation in summer.		BMS with manual overrides preferable on all windows.
7. On Site Energy Generation		Solar domestic water heating to WCs.	Solar domestic water heating to WC cores. Cost effective PV installation using PVs to shade rooflights. Gas fired CHP installation.	Solar water heating to kitchens. Maximum PV installation using most efficient PVs. Wood/waste fired CHP.	Potential 50% grant available from DTI for wolar water heating, up to 65% for PV installation.
8. Daylighting	"Reasonable" to BS8206 part 2. A 2% daylight factor.	80% office space daylit to meet criteria of BS8206: part 2.	100% of office space daylit to BS8206 part 2		Ensure prevention of solar heat gain/glare by building form/shading systems
9. Artificial Lighting Controls	PIR detectors in WCs etc. Low energy fittings throughout.	Luminance and presence detectors throughout building. No dimming.	Luminance and presence detection at all fittings with dimming to zero and BMS override.		Personalised controls strongly recommended by Rob Jarman
10. Cooling Systems/Sources	Zero ozone depletion refrigerants in high efficiency comfort cooling/air conditioning systems.	Night time structural cooling with automatic window vents.	Evaporative cooling to rooms with high internal heat gains.	Borehole/ground water cooling to rooms with high internal heat gains.	Need to provide for areas where cooling is required and provide upgrade path for entire building.
11. Embodied Energy in Structural Materials	Steel and concrete frame engineered to minimise mass of materials.	Use of cement replacements eg GGBFS in concrete. Use recycled steel.	Timber structure in lieu of steel or concrete but retaining concrete floors. Use of recycled aggregates in structural concrete.	All timber structure with thermal mass provided using minimum amount of concrete.	NB. Rob Jarman particularly keen on use of timber for low embodied energy

REF: W Gething & W Bordass, *A rapid assessment checklist for sustainable buildings,* BR&I **34**(4), 416-426 (2006).

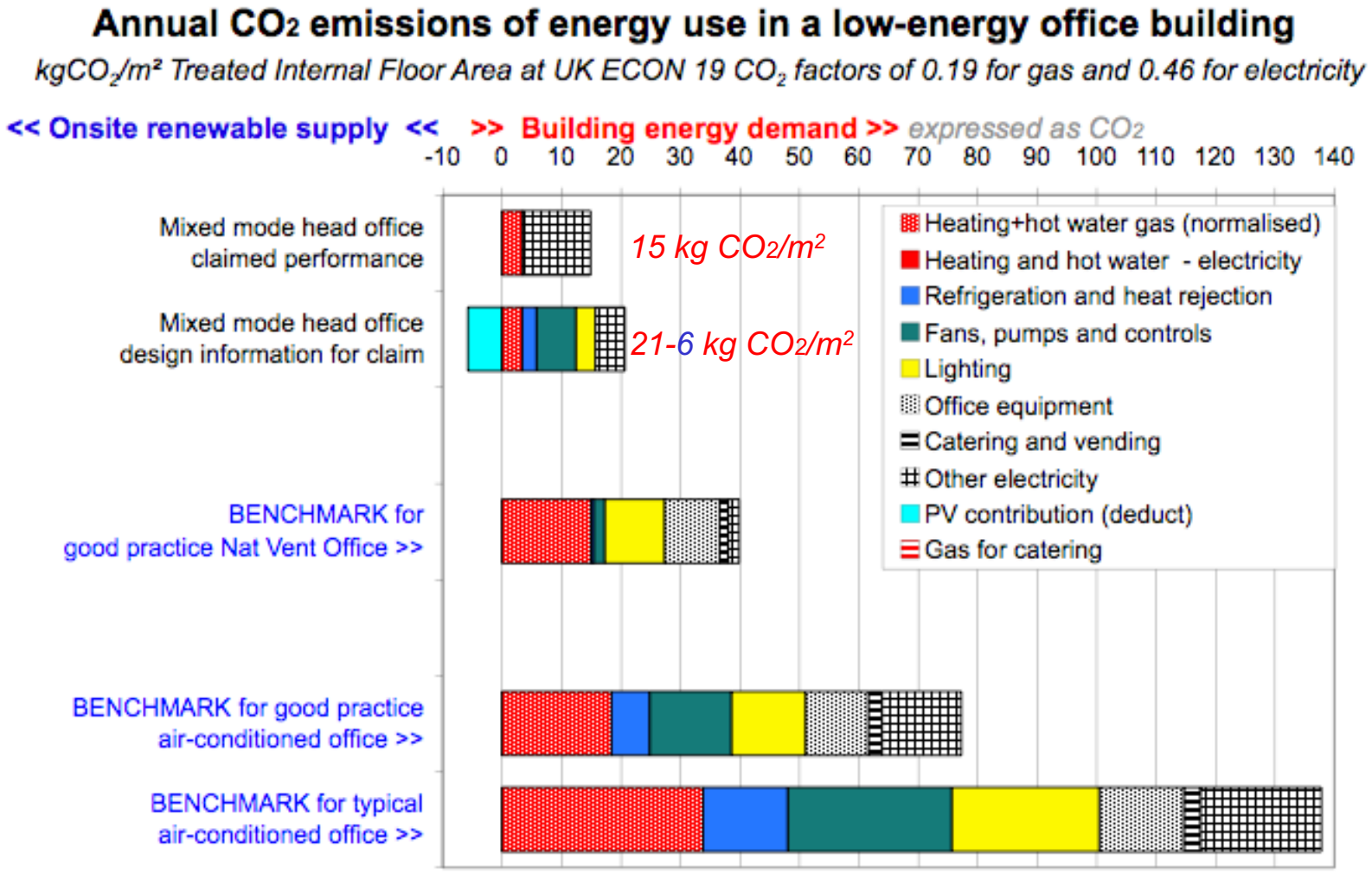
Managing expectations: an example

1: the design claim, as published



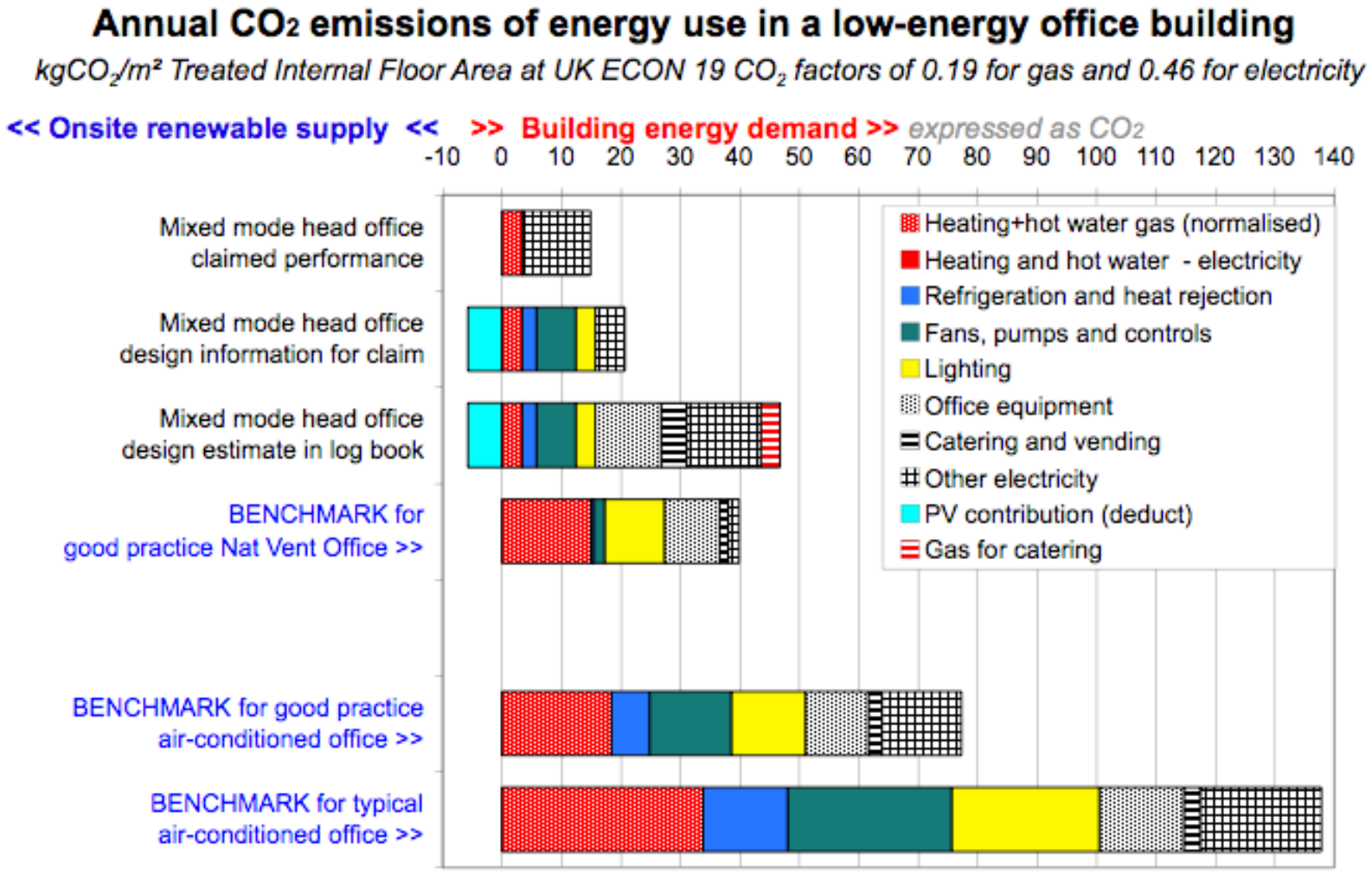
Managing expectations: an example

2: the basis for the design claim



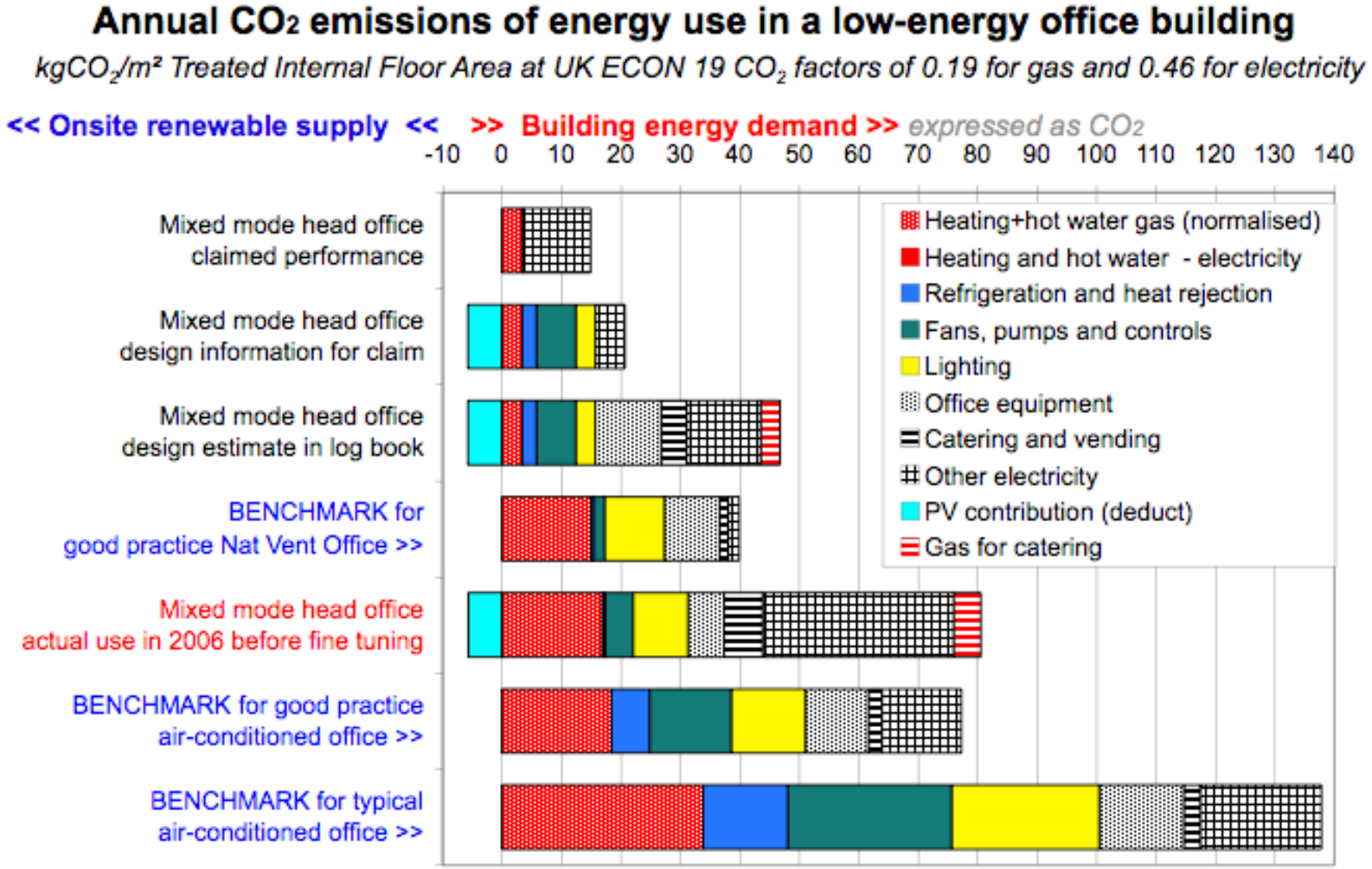
Managing expectations: an example

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



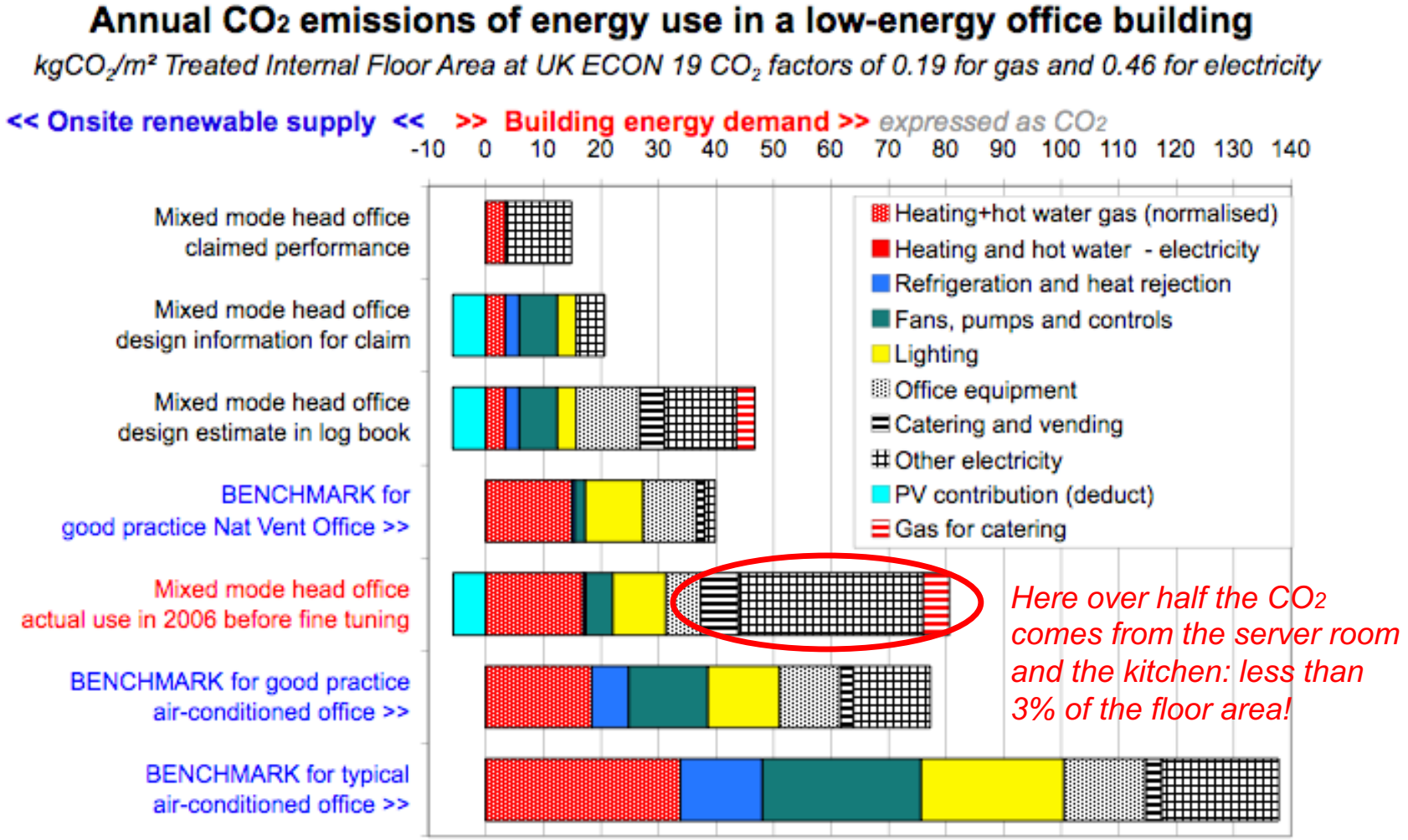
Managing expectations: an example

4: actual performance in use, before fine tuning



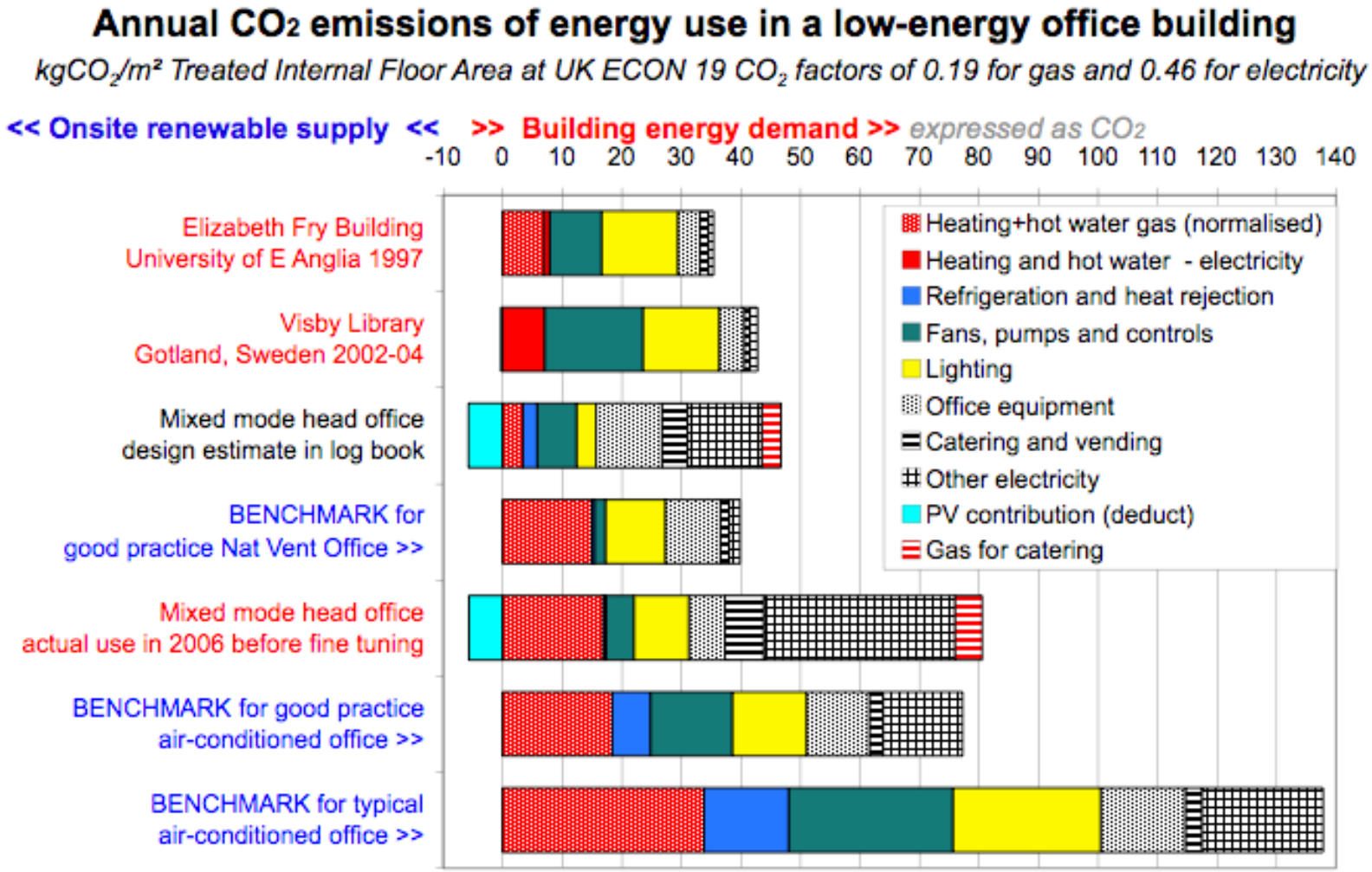
Managing expectations: an example

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

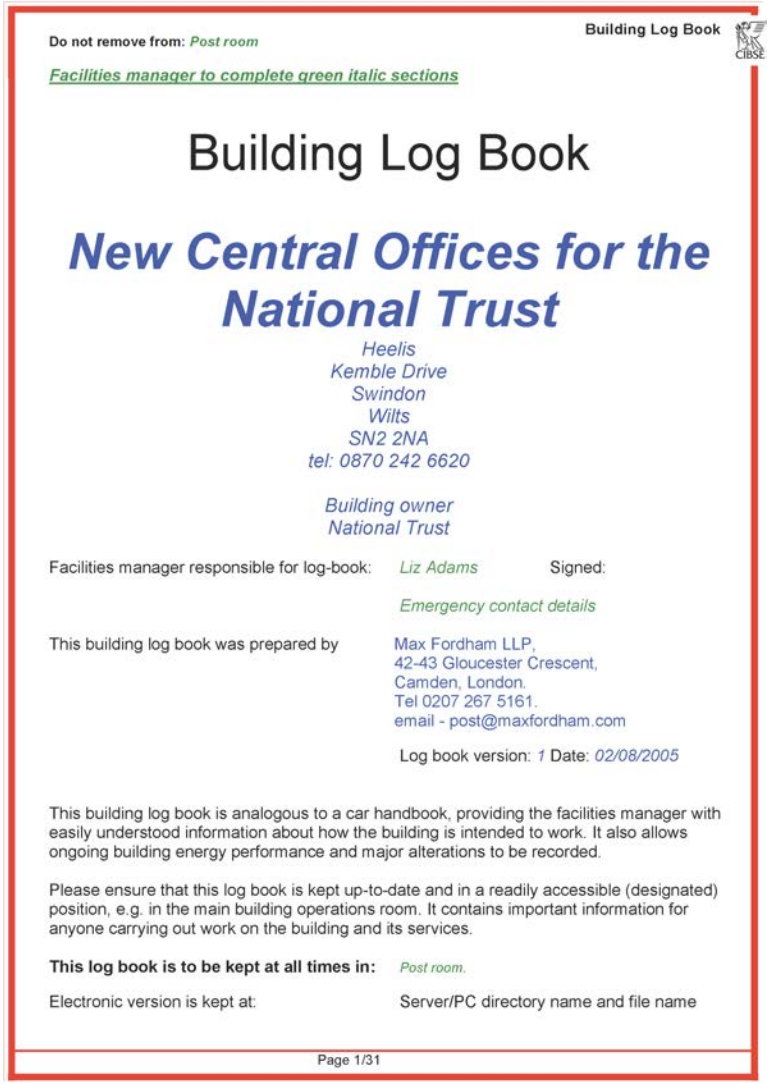


Soft Landings **Stage 3:**
Preparation for handover

- **A change in concept:**
  Handover becomes an event within an extended *Finish* stage, not the point at which the design and building team sign off and run away.
- **Preparation for operational readiness** includes not just the static and dynamic commissioning of the fabric and building services, but much closer engagement with the occupier's move-in and their management and maintenance team, *if they have one.*
- **Preparation for aftercare,** with representatives of the design and building team on site after handover.
  The time allocation depends on the size and complexity of the project - it might be one person for half a day a week or less, or much more.
- **If there is unfinished business,** e.g. owing to a forced early handover, then Soft Landings makes it much easier for the *golden thread* to be taken through into STAGE 4: initial aftercare & fine tuning.

Early appointment of a facilities management team is not enough, they also need to be brought into the process deliberately.

Soft Landings **Stage 3:**
Preparation for handover



Do not remove from: *Post room*

Building Log Book

Facilities manager to complete green italic sections

Building Log Book

New Central Offices for the National Trust

Heelis
Kemble Drive
Swindon
Wilts
SN2 2NA
tel: 0870 242 6620

Building owner
National Trust

Facilities manager responsible for log-book: *Liz Adams* Signed:

Emergency contact details

This building log book was prepared by

Max Fordham LLP,
42-43 Gloucester Crescent,
Camden, London.
Tel 0207 267 5161.
email - post@maxfordham.com

Log book version: *1* Date: *02/08/2005*

This building log book is analogous to a car handbook, providing the facilities manager with easily understood information about how the building is intended to work. It also allows ongoing building energy performance and major alterations to be recorded.

Please ensure that this log book is kept up-to-date and in a readily accessible (designated) position, e.g. in the main building operations room. It contains important information for anyone carrying out work on the building and its services.

This log book is to be kept at all times in: *Post room.*

Electronic version is kept at: Server/PC directory name and file name

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Section 3: Operating and Maintenance Instructions

CRITERION 5 – PROVIDING INFORMATION

82 In accordance with Requirement L1(c), the owner of the building should be provided with sufficient information about the building, the ***fixed building services*** and their maintenance requirements so that the building can be operated in such a manner as to use no more fuel and power than is reasonable in the circumstances.

Building log-book

83 A way of showing compliance would be to produce information following the guidance in CIBSE TM31 Building Logbook Toolkit[32]. The information should be presented in templates as or similar to those in the TM. The information could draw on or refer to information available as part of other documentation, such as the Operation and Maintenance Manuals and the Health and Safety file required by the CDM Regulations.

84 The data used to calculate the ***TER*** and the ***BER*** should be included in the log-book.

It would also be sensible to retain an electronic copy of the input file for the energy calculation to facilitate any future analysis that may be required by the owner when altering or improving the building.

SOURCE: CIBSE Technical Memorandum TM31, *Building Log Book Toolkit* [2006] and Building Regulations ADL2 (2002 et seq).

Soft Landings **Stage 4:**
Initial aftercare

- **Design and building team members visit regularly:**
  who and how many visits will depend on project.
- **They need a home in the building where they are visible to occupants,** *and not hide in the site hut.*
- **They explain the building to the users,**
  in simple guides and in one or two introductory events.
- **They help the management to take ownership,**
  the occupier must take the initiative, not stand back.
- **They keep people informed,** *e.g. via a newsletter on the organisation's website, e.g. alerting to any problems.*
- **Troubleshooting and fine tuning can be undertaken,**
  the best insights have been where SL team members do some of their own work in the building and get first hand experience of its facilities.

FEEDBACK: Contractors find it difficult to engage properly.
Aftercare priorities are different from just dealing with snags and defects.

Without aftercare, designers may never learn from unintended consequences

Occupant dissatisfaction with gloomy solar film

After refurbishment of a university building in 2014

SOFT LANDINGS FOR SCHOOLS

Case Studies

Feedback from use of the Soft Landings Framework in new schools

Edited by Mike Buckley, Bill Bordass and Roderic Bunn

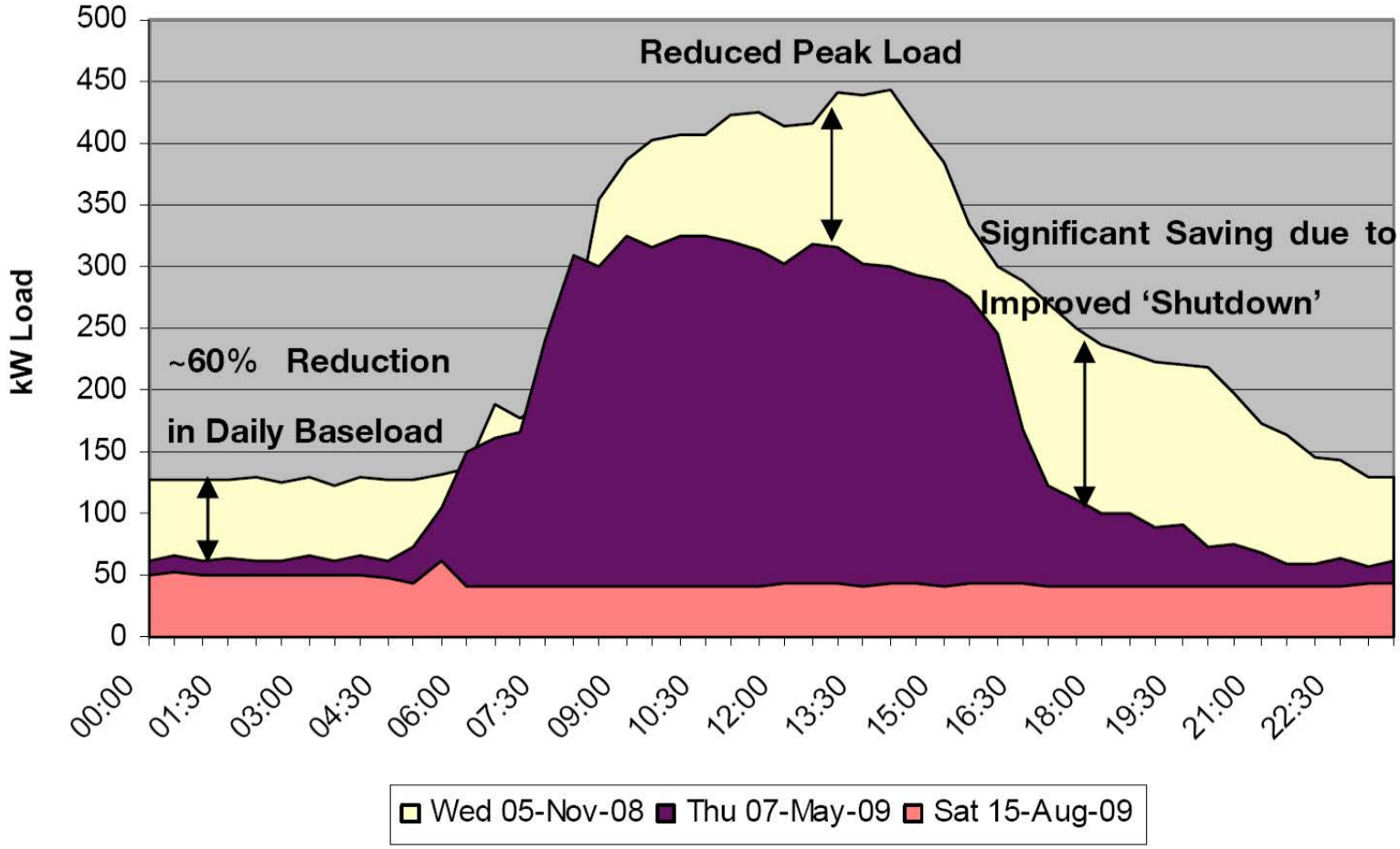
BSRIA BG 9/2010

SOFT LANDINGS

Research funded by
Technology Strategy Board

Follow-through aftercare often pays for itself

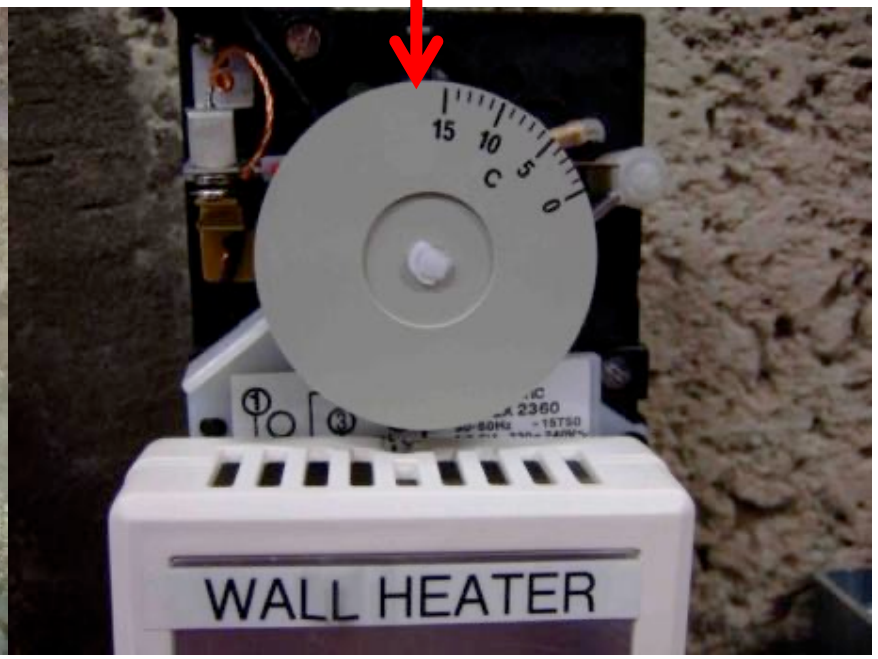
Intervention in a new secondary school



Saving over £ 50,000 p.a. in electricity bills: avoid default to ON

SOURCE: Buro Happold Engineers, *Soft Landings Trials* (2009).

Stages 4+5 can trap unintended consequences:
Example: sprinkler frost protection in a primary school



In 2008-09, this frost thermostat *(improperly set at 17° C on installation)* energised the wall heater in the sprinkler pump room. Over a year, this wasted more electricity than the wind generator *(intended to offset the entire building's annual heating energy use)* produced.

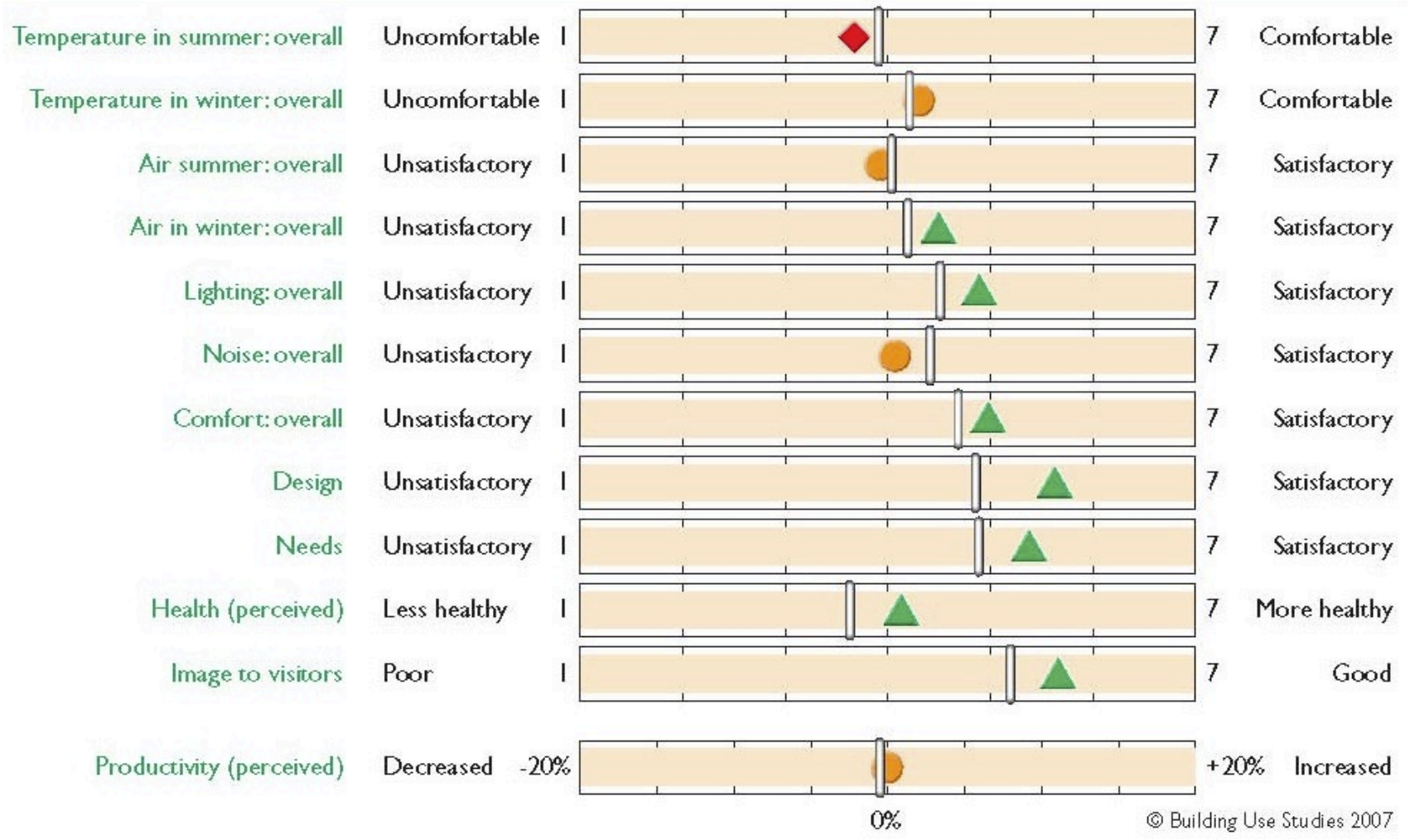
Soft Landings **Stage 5:**
Monitoring, evaluation and feedback

- **Extended aftercare period,** typically two or three years.
- **Occupiers must take ownership** and do most of the monitoring themselves. *They may need motivating.*
- **Independent post-occupancy evaluation (POE) can be included,** e.g. for occupant surveys, energy analysis & structured discussions. *Independent review & benchmarking can be helpful and reassuring.*
- **The findings can be fed through rapidly,** *e.g. to fine tune the systems, refine use and operation of the building and plan upgrades.*
- **The learning can also be spread much more widely,** via the people and organisations involved, and beyond.

FEEDBACK: Often this has needed external funding.
How can we make it routine? The value that can be added is enormous.

We can't afford not to do it; and it can be done with a light touch.

BUS questionnaire survey at Heelis



The building was subsequently tuned and satisfaction improved, then deteriorated after savings on FM, which were later restored.

SPREADING THE WORD:
Heelis designers report back in public

bsj building services journal: the magazine of CIBSE

Ba-graph-1-.jpg

2007-Study.jpg

Images

Building Analysis

So, how are you doing?

November 2007

Heelis, the National Trust's HQ in Swindon, is two years old. Senior engineer at Max Fordham Guy Nevill, who helped design it, takes a look at how it's been performing

By Guy Nevill

When the National Trust decided it needed a new headquarters to bring together staff from four different sites around the country, sustainability was a big part of the brief. The new building, Heelis, has now been in use for two years, so it is a good time to review how it is performing.

The Heelis complex, which covers about 7000m2 and accommodates 470 people, was designed by architect Feilden Clegg Bradley with Max Fordham as M&E consultant. The site in Swindon once formed part of Isambard Kingdom Brunel's Great Western Railway Works. The total cost was £16.73 million.

SOURCE: Building Services Journal, 32-37, (November 2007).

GAINING CLIENT CONFIDENCE:
Heelis FM comments in 2007

Heelis building facilities manager **Liz Adams** educated the staff on what to expect from their new home.

"We told users not to expect stable conditions. We call it a 'layers building' as it won't suddenly react to changes in weather conditions, but take a while to heat up and cool down. So we remind people in September to bring in a cardigan.

"In the Autumn, when the outside temperature drops overnight, the building won't necessarily react immediately. So out come the cardies.

"Comfort has been better in year two as the building has settled into a pattern. People are far more used to how the building's systems work. The biggest problem is managing expectations about what the building will do in summer.

"We commissioned Max Fordham to carry out monitoring and fine tuning in the first two years. We have a good relationship with the design team – it's been fantastic."

SOURCE: R Bunn, *Trust in construction,* BSRIA Delta T, 10-13, (March 2007).

Feeding forward in phased projects:

Window control improvements at Cambridge Maths building

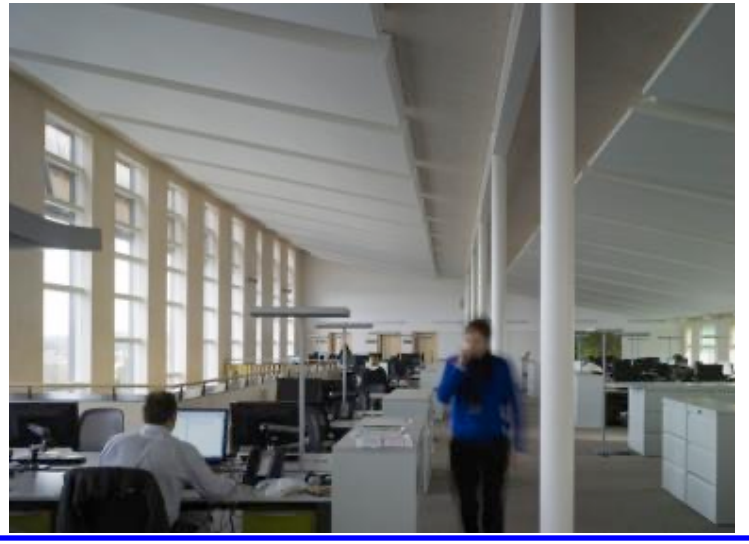
PHASE 1 **>>>**

- Difficult to understand
- Some poorly located
- Remote control problems

PHASE 2

- Improved, custom design
- Better located
- Not yet perfect

Feeding forward between projects:
National Trust to Woodland Trust



Soft Landings and POE:
Everybody can win

- Better communication, proper expectations management, *fewer nasty surprises.*
- More effective building readiness. *Less rework.*
- Natural route for feedback and Post-occupancy evaluation, *to improve the product and its performance in use.*
- Teams can develop reputations for customer service and performance delivery, *build relationships, retain customers, improve commercial advantage.*
- Vital if we are to progress towards more sustainable, low-energy, low-carbon, well-liked buildings and refurbishments, *closing the credibility gaps.*

SO WHAT'S STOPPING US?

- ***ATTITUDES**: Everybody needs to be committed, starting with the client - perhaps the biggest obstacle. The "golden thread" needs to be put in place.*
- ***PROCESSES**: There is a learning curve to pay for (perhaps best from marketing budgets). The feedback information also has to be managed.*
- ***CAPACITY**: We need facilitators, investigators, troubleshooters and fixers.*
- ***MONEY**: Ringfenced budget for POE, tune-up etc. after practical completion.*
- ***IMAGINATION**: Often constrained by burgeoning bureaucracy!*

IN FUTURE: Moving from design for compliance to *Design for Performance*

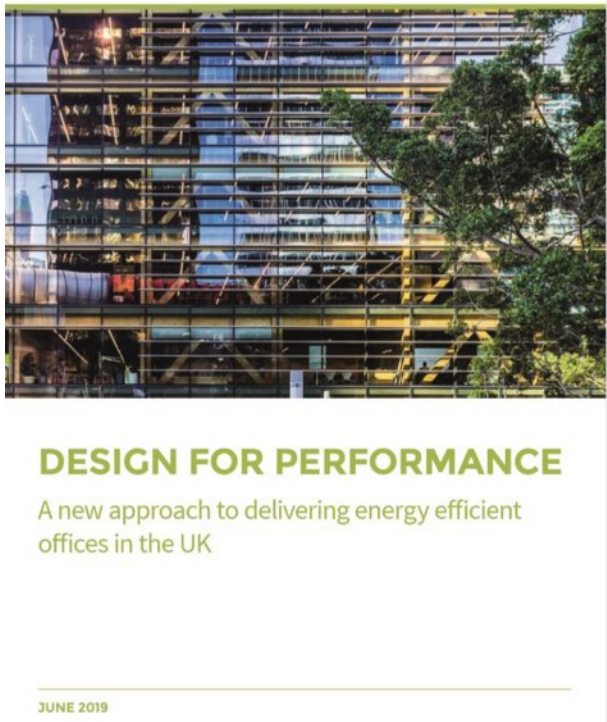
BBP | BETTER BUILDINGS PARTNERSHIP | OUR RESOURCES | OUR MEMBERS

Design for Performance

The Design for Performance Project is an industry initiative led by Verco and including BSRIA, Arup and the Usable Buildings Trust (UBT), and supported by the BBP, which aims to change the way we design new office developments in the UK. The project looks abroad to the hugely successful Australian NABERS Commitment Agreement and explores the applicability and opportunity of developing and testing such a framework in the UK.

The energy efficiency of new offices in the UK is subject to Building Regulations Part L and represented in market transactions by Energy Performance Certificates (EPCs). Developers, owners and occupiers of new and refurbished buildings might reasonably expect that these mechanisms will produce a building that is energy efficient in operation. However, both focus on design and technology that improves predicted building performance, not on achieving directly measureable improvements in performance in-use.

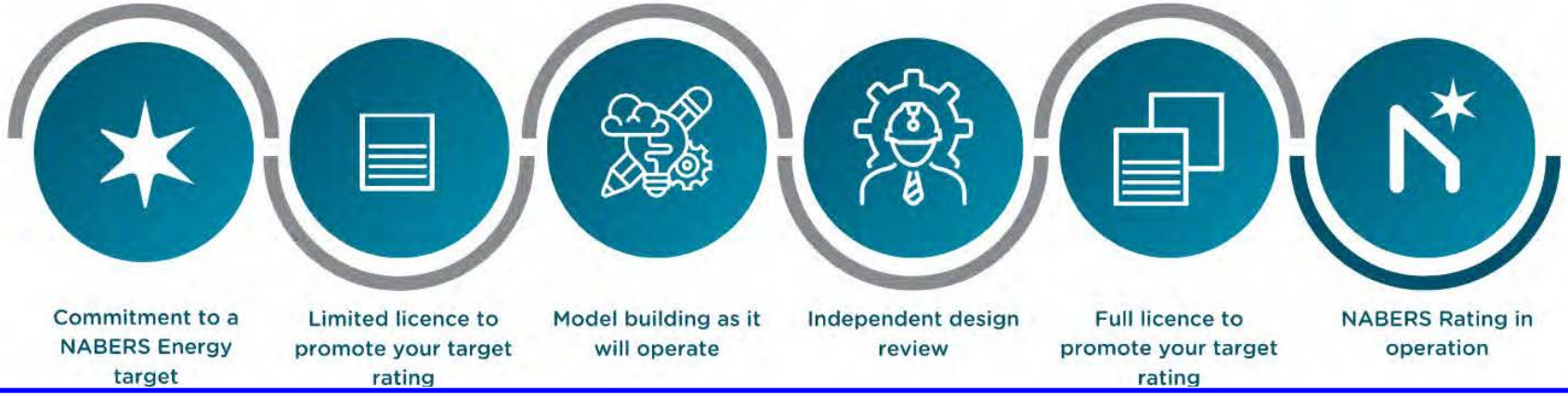
The consequence has been a *design-for-compliance* culture, and a disconnect between the regulatory framework and the influence it has on the energy use and associated carbon emissions it is supposed to be limiting – the so-called 'Performance Gap'. Voluntary



FOR THE LATEST INFORMATION GO TO: www.betterbuildingspartnership.co.uk/node/360

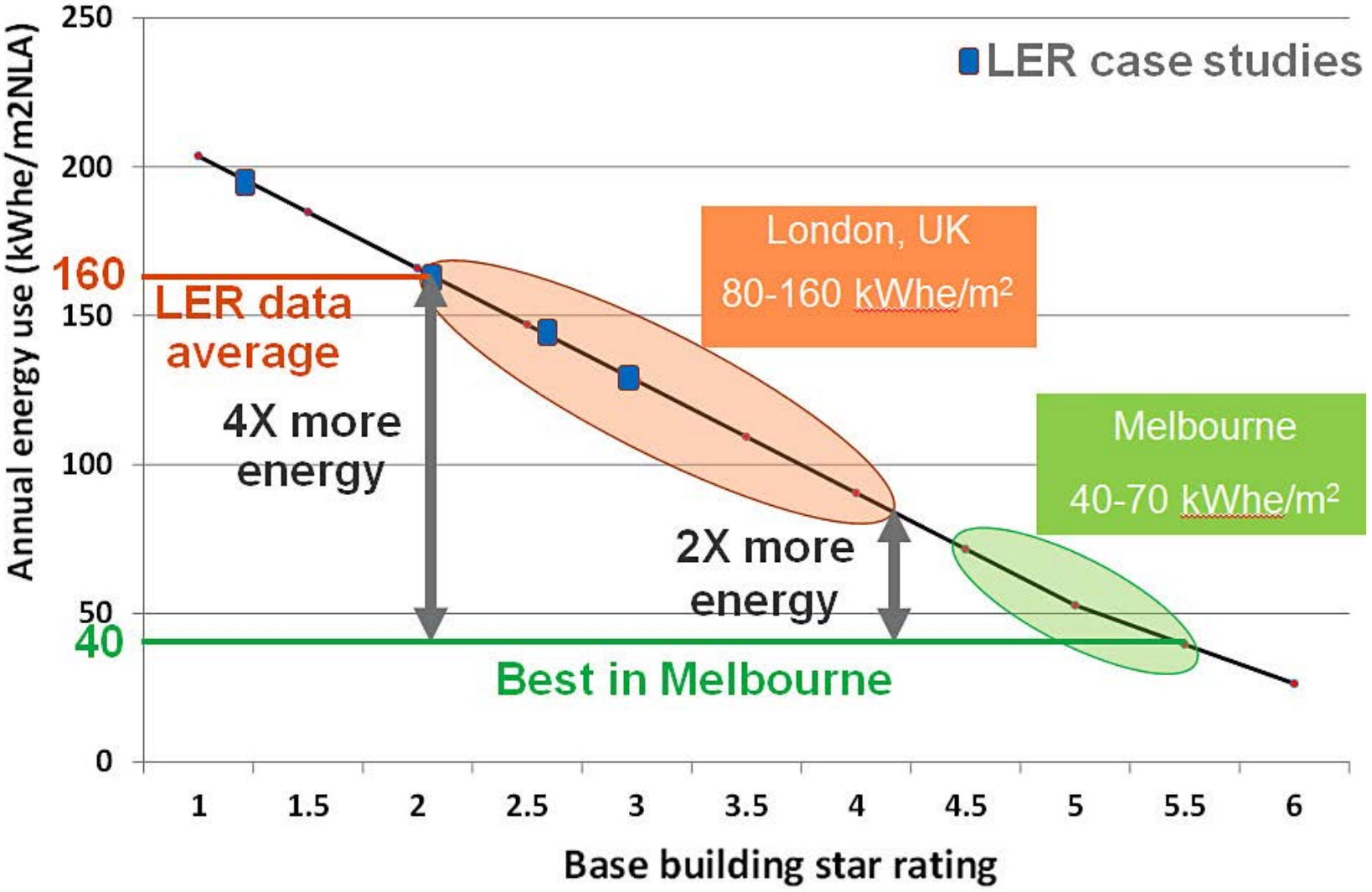
Design for Performance CAs - *Commitment Agreements, as developed by NABERS in Australia*

- Developer signs up to provide guaranteed in-use energy performance for the "Base Building" – *the landlord's areas and services.*
- All new members of the design, construction and management team sign up to a *Commitment Agreement.*
- Modelling *includes assessment of controls and "off-axis" scenarios.*
- Design and Model reviewed by *independent assessors.*
- Metering systems allow *outcomes* to be reviewed.
- The completed building is *fine-tuned* as necessary.
- Results are *benchmarked and reported.*



SEE: www.betterbuildingspartnership.co.uk/resources?topic=24 and www.cibse.org/nabers-uk

Potential reward in landlord annual energy use:
London (without CAs) & Melbourne (with CAs)



SOURCE: R Cohen, P Bannister, B Bordass, *NZE buildings in reality, not just in theory,* REHVA Journal, 56-59 (May 2016).

Might we be starting to get there? **OPERATION**

Far too late: *we could have used DECs 15 years ago*

Grosvenor / News & insights / Grosvenor achieves UK's first NABERS UK rating at Toronto Square, Leeds

Grosvenor achieves UK's first NABERS UK rating at Toronto Square, Leeds *[4.5 Stars in use]*

04 JULY 2022

Going for Zero

Our 2020 Pathway Report

SOURCE: www.grosvenor.com/news-insights/grosvenor-achieves-uk's-first-nabers-uk-rating-at-toronto-square,-leeds (4 July 2022)

Might we be starting to get there? **DELIVERY**

Far too late: *we could have had integrated certification*

Leeds office achieves 5-Star NABERS UK Energy Rating

The 11&12 Wellington Place office development in Leeds has made history by becoming the first new building in the UK to achieve a 5-star NABERS UK energy rating. For the engineering team, it's just the beginning, as they push for even greater efficiencies to future-proof the investment

Posted in October 2025

'Five stars is excellent, but that's just the starting point for us. We see this building as having a lot more to give,' says Brad McHale, principal mechanical engineer at Arup. McHale is talking about the speculative office building 11&12 Wellington Place, Leeds, which has made history by becoming the first new building in the UK to achieve a NABERS UK 5* Energy Rating.

SOURCE: *Aiming for the Stars,* CIBSE Journal, 22-26 (November 2025).

Conclusions

- If we are to meet the challenges of sustainability, the role of the building professional must change radically.
- Instead of drifting away from good initial intentions, projects must converge onto good in-use outcomes.
- This needs routine follow-through, assessment, review and reflection, *to close feedback loops & initiate virtuous circles.*
- It needs leadership, *not more and more bureaucracy.*
- **Building performance in use needs to become an independent knowledge domain,** *to support & challenge industry & policy, properly resourced in the public interest.*

It's about everything – not just energy and carbon
It's far too important to leave to the construction industry.

THE FUTURE: New professionals follow through design intent into reality

- Understand what is needed — *strategic briefing*
- Make their overall expectations and intentions clear — *strategic design*
- Are ambitious, but realistic — *question assumptions, understand user needs*
- Confirm that things will work — *technical feasibility, usability and manageability*
- Tell others what is expected — *specify not just what, but why and how*
- Follow things right through the whole process — *e.g. using Soft Landings*
- Collaborate to get things done well — *communicate, train, inspect*
- Reflect on progress — *manage expectations, undertake reality checks*
- Finish things off — *commission, operational readiness, handover, dialogue*
- Help users to understand and take ownership — *provide aftercare support*
- Review performance in use — *including **POE and BPE***
- Work with occupiers to improve things — *monitoring, review and fine tuning*
- Anticipate and spot unintended consequences — *revenge effects*
- Learn from it all — ***and share the experiences***

The New Professionals: THAT'S YOU !

Thank you **Final Questions?**