Centre for Alternative Technology, Macynnleth
11 December 2025

BUILDING PERFORMANCE IN USE, PROFESSIONALISM and PROPORTIONATE RETROFIT

Bill Bordass

USABLE BUILDINGS
www.usablebuildings.co.uk

OUTLINE

1. Building performance in use: *The great unknown?*
2. Some strategic lessons from BPE and POE
3. Why aren't we better tuned in to outcomes?
4. Implications for professional practice
5. The value routine POE can bring
6. How might this affect low-carbon retrofits?

PART 1

BUILDING PERFORMANCE IN USE:
THE GREAT UNKNOWN?

Better 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 buildings and the built environment 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 REALLY UNDERSTAND WHAT WE ARE DOING?

Post-Occupancy Evaluation
or Building Performance Evaluation?

Post-Occupancy Evaluation

- Exposes a construction industry perspective,
  with handover seen as the end, not the beginning!
- Too often regarded as academic and mostly about perceptions
  in fact, multiple methods, combining "soft" and "hard" data, can often lead to more valuable insights.

Building Performance Evaluation

- *A more general term.*
- *It can cover any type of investigation, at any depth & any time.*

I and colleagues now prefer to restrict the POE term to:

Packages of BPE activities that are well-integrated into a client, design + building team's work programmes for procuring or changing a building.

Getting building teams started on POE:
it's not that difficult !

Adopt a drill-down approach where practicable:

1. BASIC: *the wet finger*
2. INTERMEDIATE: *get some useful data*
3. ADVANCED: *deeper investigation.*

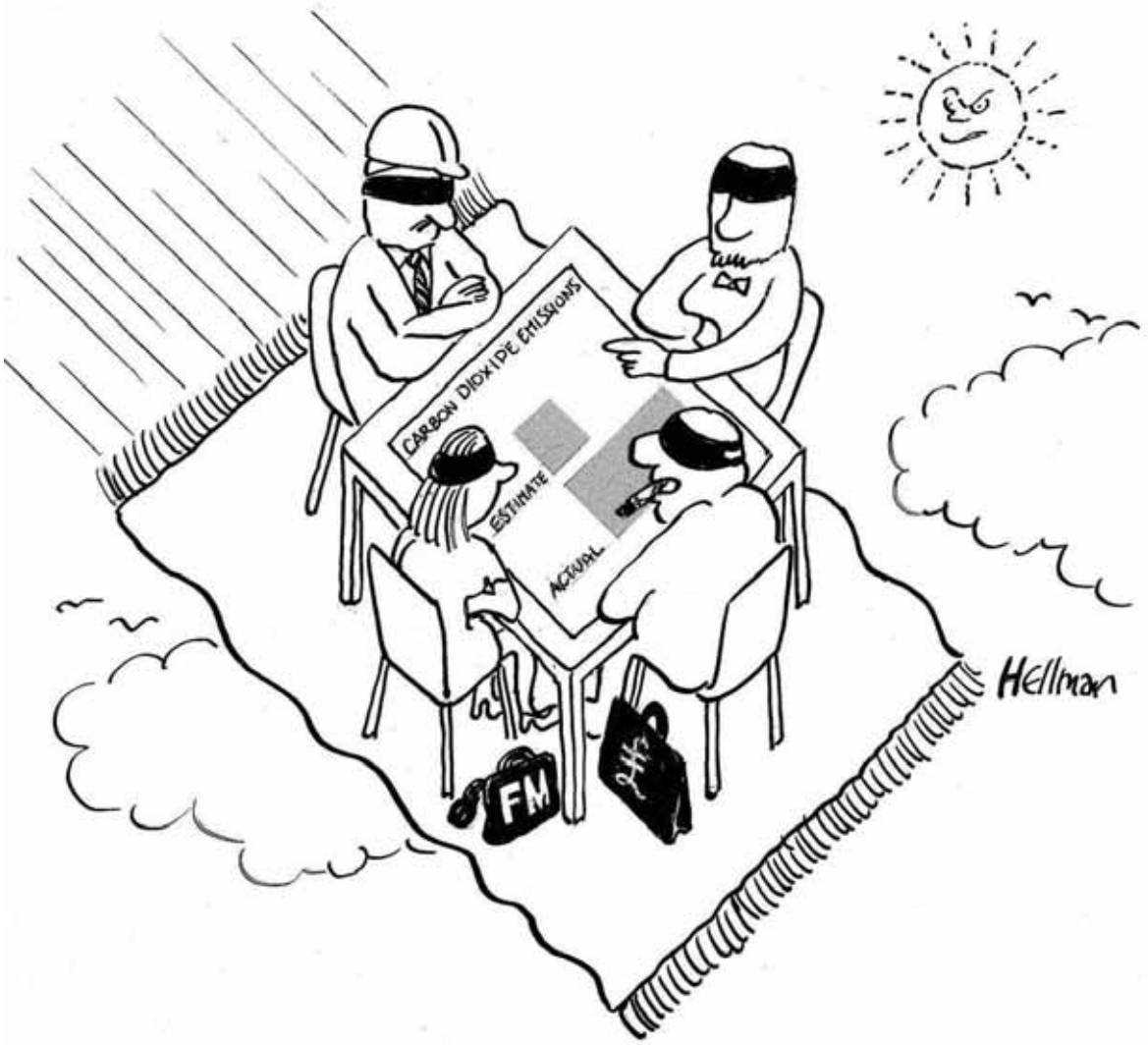
None of these levels is academic research in the traditional sense:
We see that as Level 4.

Ideally, beyond the Basic level, work should be both:

- ***Separated*** from the client, design and building team:
  this helps provide objectivity and a wider view.
  It can involve a mentor, consultants, or academic input.
- ***Connected****,* to allow the individuals directly involved in a building project to learn through personal experience and take this back into their organisations and to the wider world.

SOURCE: The three-level classification follow that in the ASHRAE *Performance Measurement Protocols* Guide (2010).

But 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).

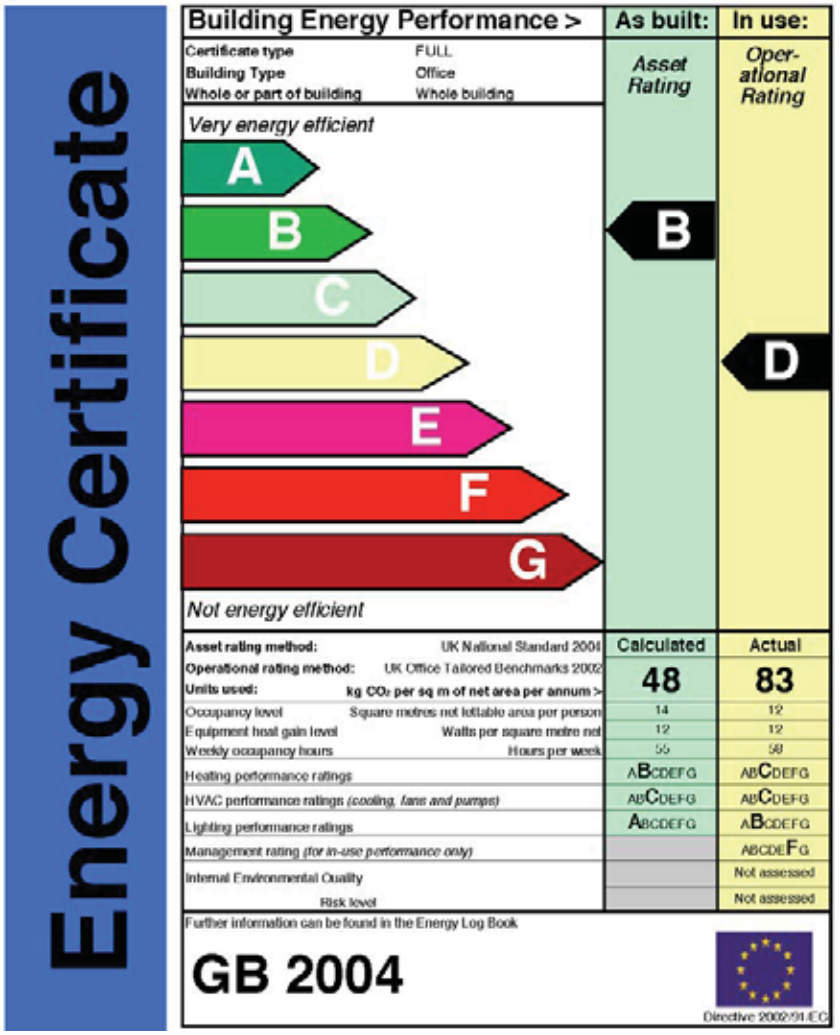
It might have been very different
had government taken energy certificates seriously

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.



B Bordass et al, *Energy Performance of Non-Domestic Buildings: Closing the Credibility Gap,* IEECB (2004). See usablebuildings.co.uk

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 so often ignore advance warning signals - the dead canary in the coal mine? **SEEKING MORE DATA IS TOO OFTEN A DELAYING TACTIC.**

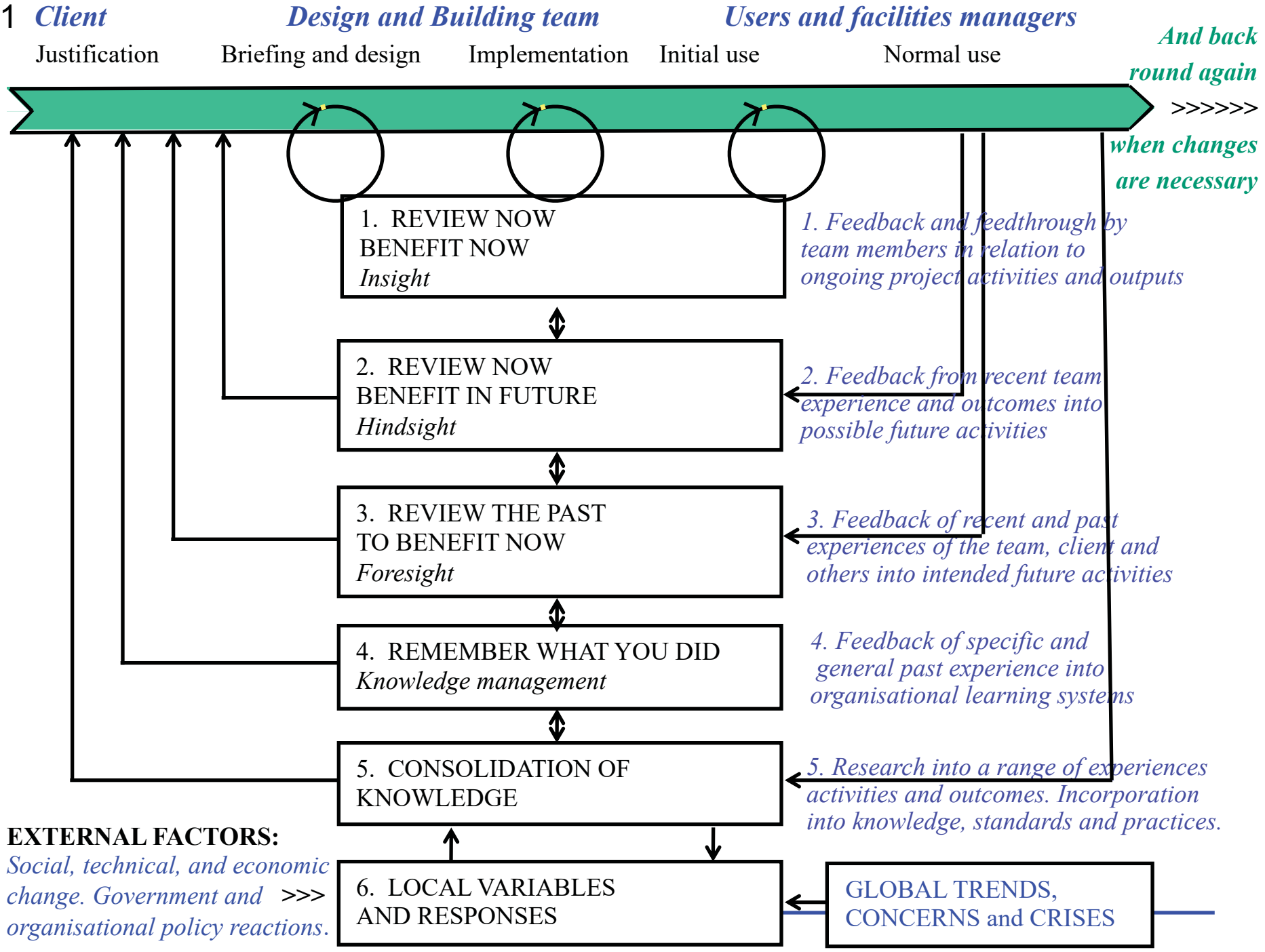
REFERENCE: B Flyvbjerg, *Five misunderstandings about case study research,* Qualitative Enquiry ***12***, 219-245 (2006),

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

AMORY LOVINS
Rocky Mountain Institute

Feedback processes occur at many levels

SEE NEXT SLIDE


Client
Design and Building team
Users and facilities managers
Justification
Briefing and design
Implementation
Initial use
Normal use
And back round again >>>>>>
when changes are necessary
1. REVIEW NOW BENEFIT NOW
Insight
1. Feedback and feedthrough by team members in relation to ongoing project activities and outputs
2. REVIEW NOW BENEFIT IN FUTURE
Hindsight
2. Feedback from recent team experience and outcomes into possible future activities
3. REVIEW THE PAST TO BENEFIT NOW
Foresight
3. Feedback of recent and past experiences of the team, client and others into intended future activities
4. REMEMBER WHAT YOU DID
Knowledge management
4. Feedback of specific and general past experience into organisational learning systems
5. CONSOLIDATION OF KNOWLEDGE
5. Research into a range of experiences activities and outcomes. Incorporation into knowledge, standards and practices.
EXTERNAL FACTORS:
Social, technical, and economic change. Government and organisational policy reactions. >>>
6. LOCAL VARIABLES AND RESPONSES
GLOBAL TRENDS, CONCERNS and CRISES

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).

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

- 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 and CoW).*

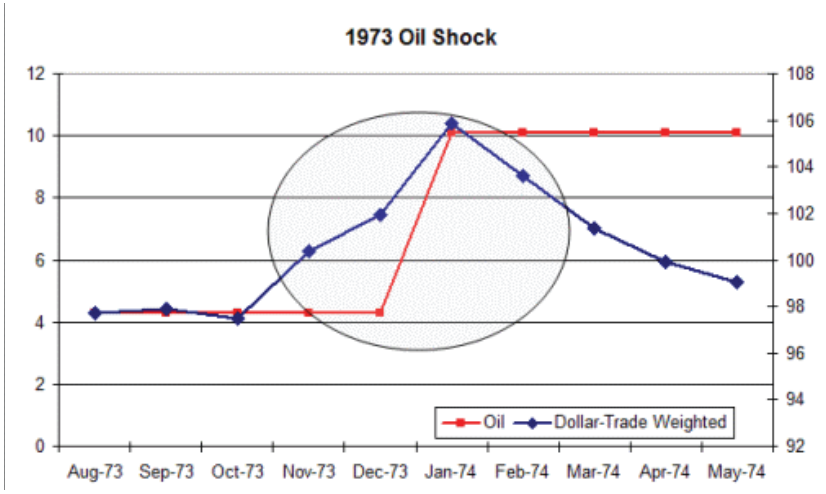
- Well-built *(attention to detail, but still room for improvement).*
- Well controlled *(but only eventually, after monitoring and refit).*
- Post-handover support *(triggered by independent monitoring).*
- Management vigilance *but could it be sustained?*

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

PART 2

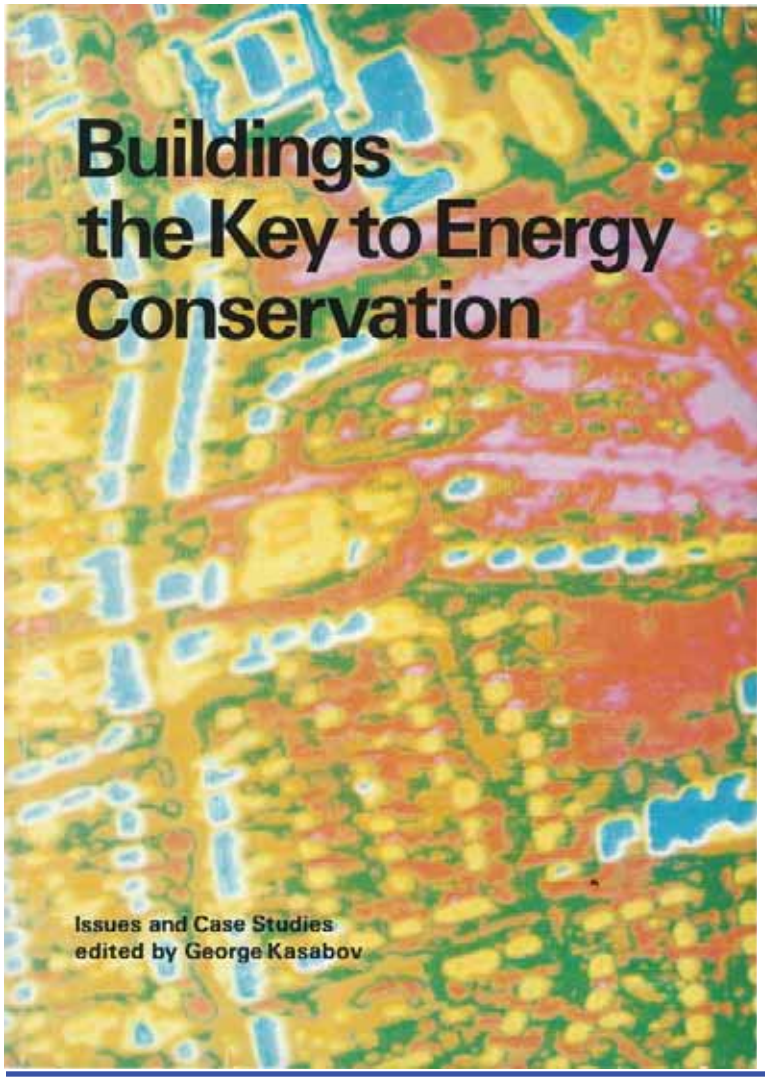
STRATEGIC LESSONS FROM PERFORMANCE EVALUATIONS OF BUILDINGS IN USE

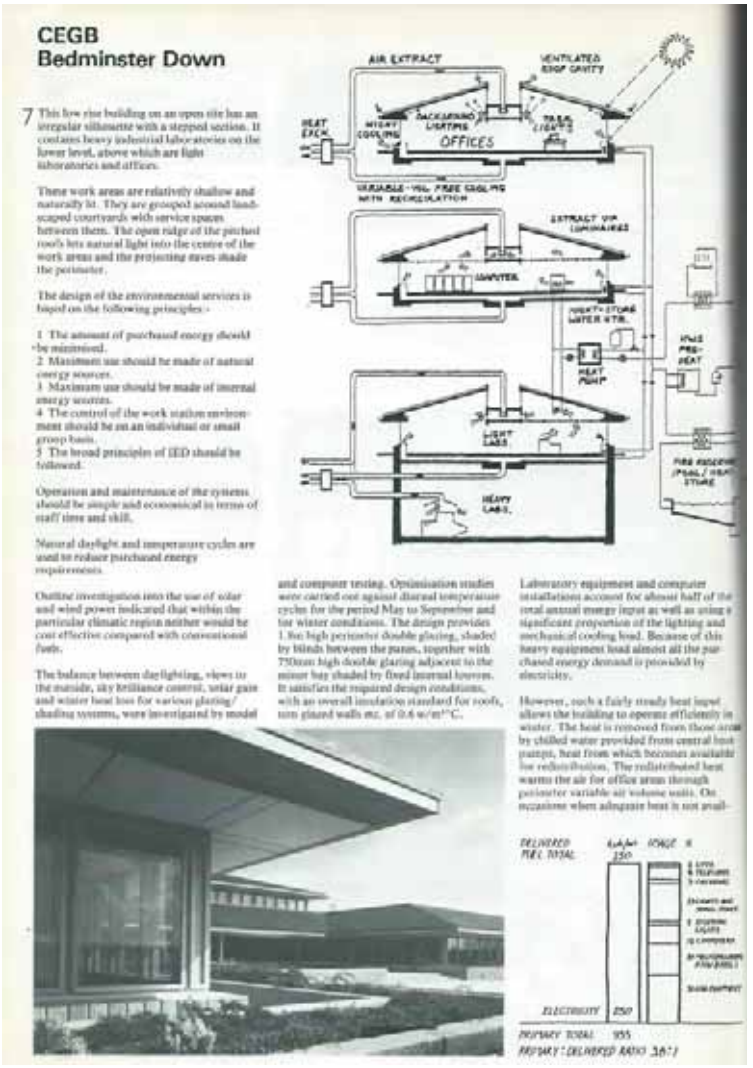
At the end of 1973, we had the oil crisis



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*





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

Building-related ill-health also joined the agenda

The WHO recognised Sick Building Syndrome in 1982

Also identified as Tight Building Syndrome in the USA

Source of diagram optipura.com

but in the UK, a decade later, in 1990 …

and in other countries too

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.

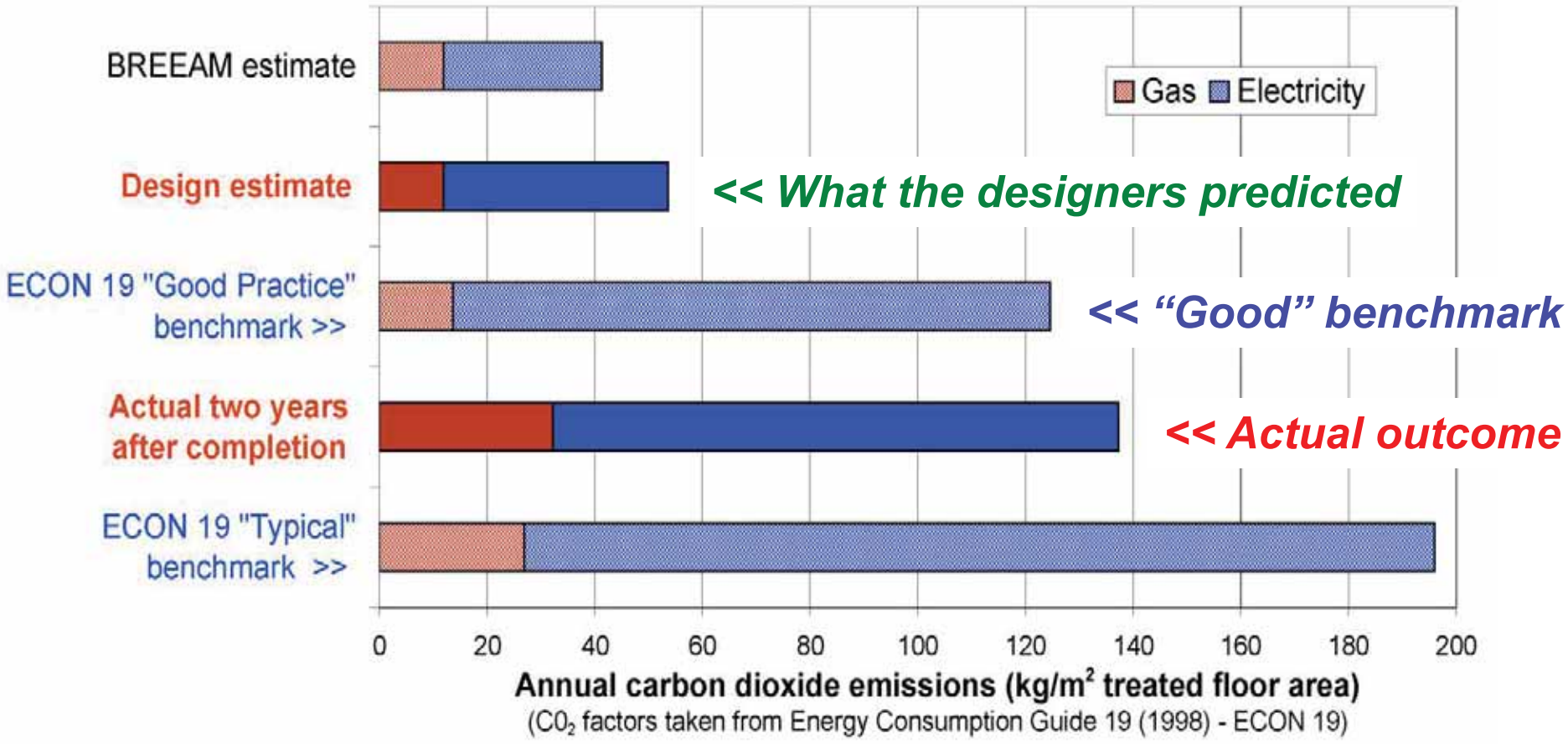
In addition, tenants can be confused about who pays for services, resulting in the doubling-up or omission of important elements of the energy bill.

The next problem concerns the assumptions that the people

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

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

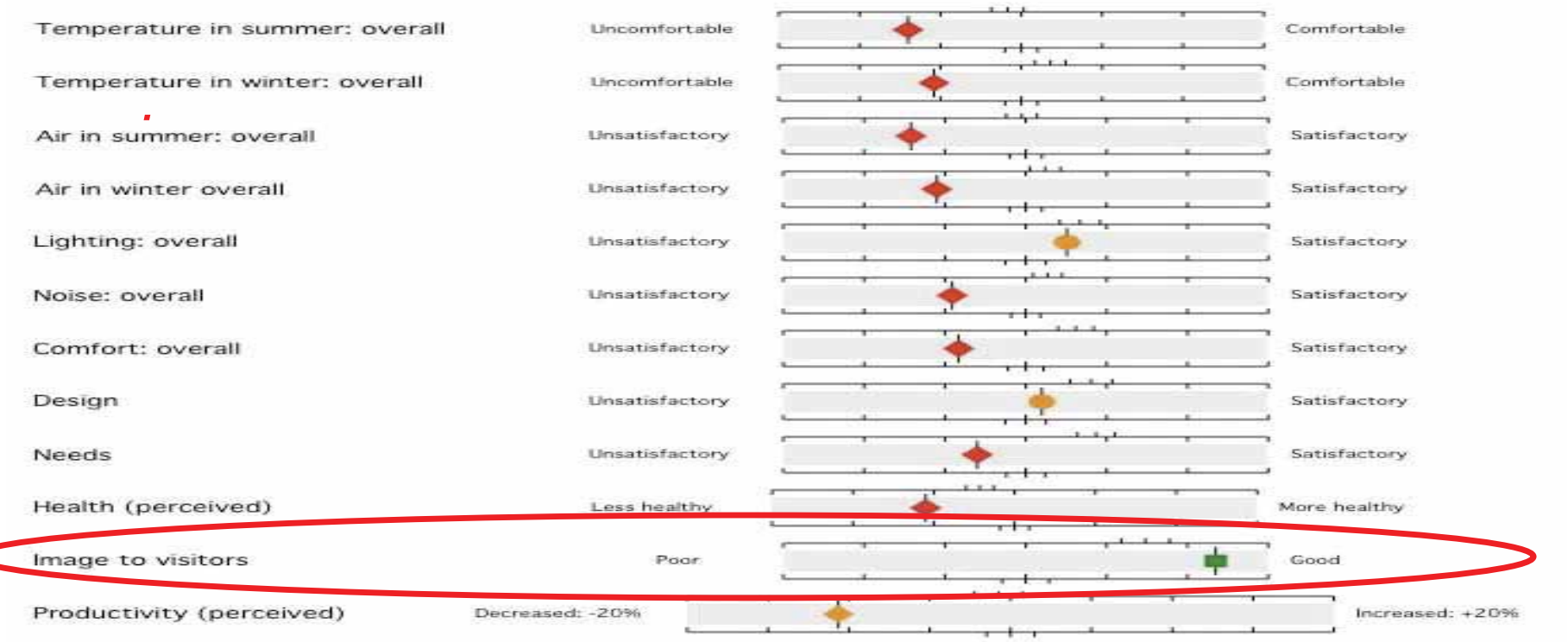
Data from the winner of the Green Building of the Year Award 1996



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

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

New non-domestic buildings:

Some strategic implications from the Probe project's findings

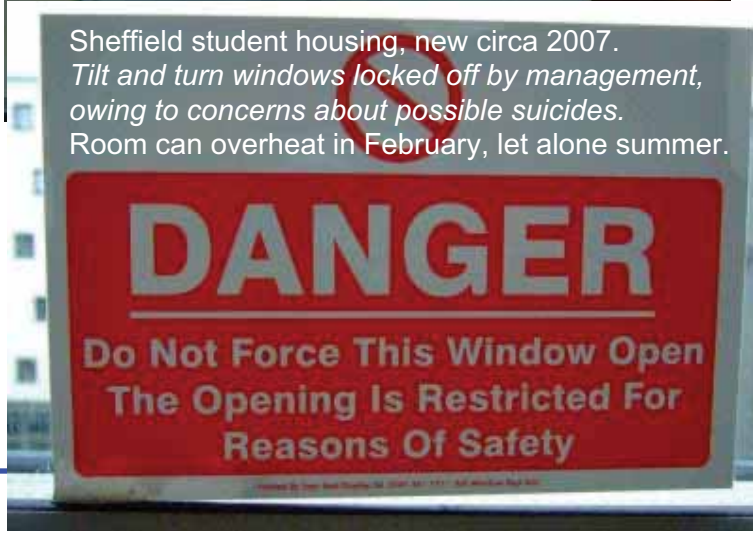
- They often perform much worse than anticipated, *especially for energy and carbon, often for occupants, and with high running costs, and sometimes technical risks.*
- Design intent is not communicated well through the process. **SO …** *Understand how buildings work in use, follow through after handover, 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

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

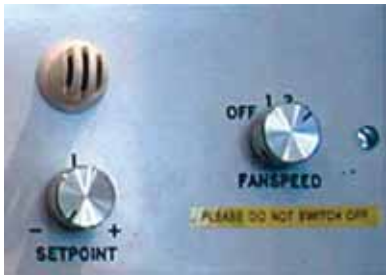
BCIA
Building Controls Industry Association

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.



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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

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).

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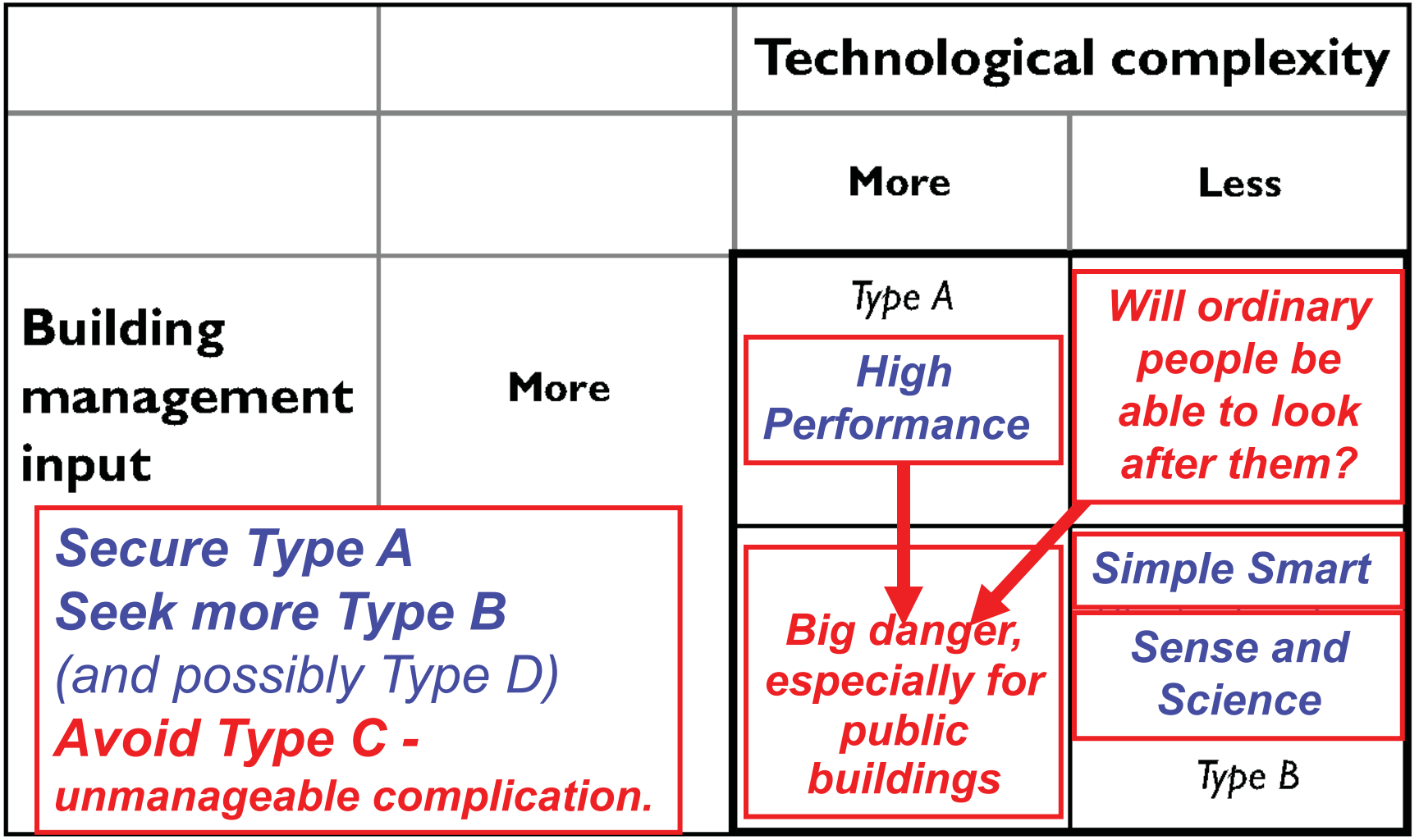


Diagram first appeared in: *Probe 19: Designer Feedback,* Building Services, the CIBSE Journal, page E21 (March 1999).

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


5 vans on callout at CSH Code 5 sheltered housing.

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).

And 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.

AND ON IT GOES ...

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

PART 3

WHY AREN'T CLIENTS, DESIGNERS, BUILDERS, MANAGERS and GOVERNMENT BETTER TUNED IN TO PROJECT OUTCOMES?

Over 60 years ago, RIBA put a feedback stage in its **Plan of Work (1963): STAGE M**

PURPOSE

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

TASKS TO BE DONE

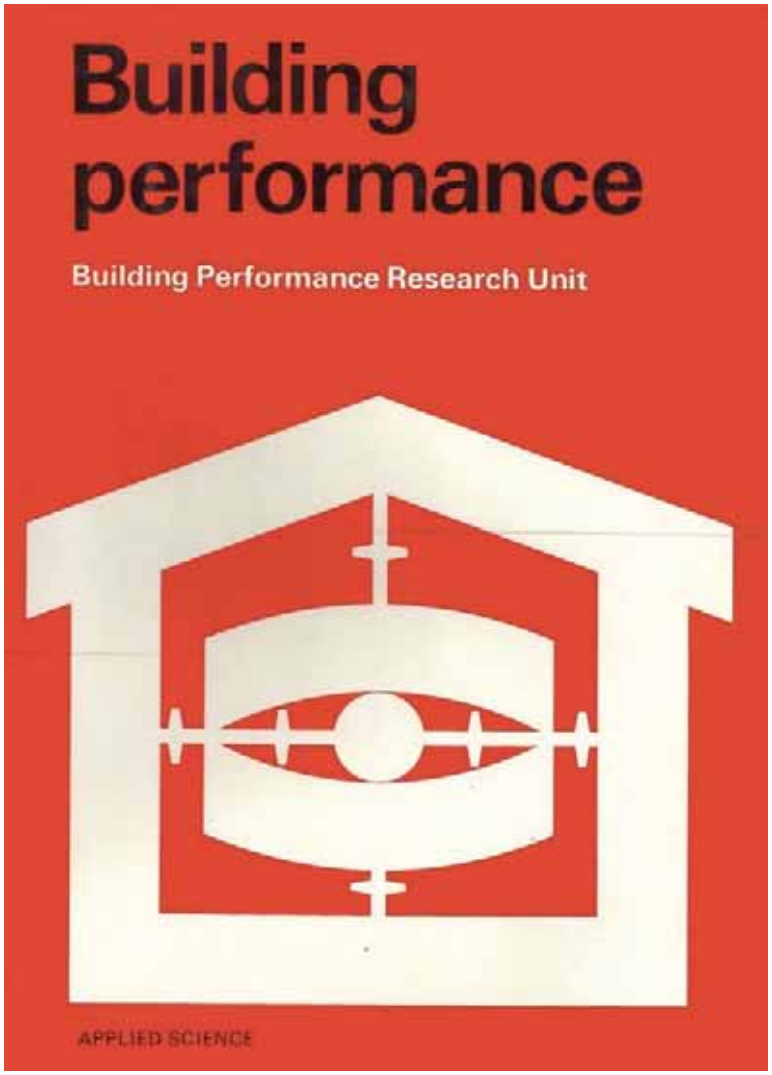
Analysis of job records.
Inspections of completed building.
Studies of building in use.

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.***

Half a century later, and in spite of numerous efforts: "finish, hand over and go away" is still deeply embedded in too many client and industry procedures and contracts.

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.
- In 1972, the Rothschild Report advocated a customer-contractor relationship for government-sponsored applied research, *followed by:*
- 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.
- *This all eroded Rothchild's idea of an intelligent government customer.*

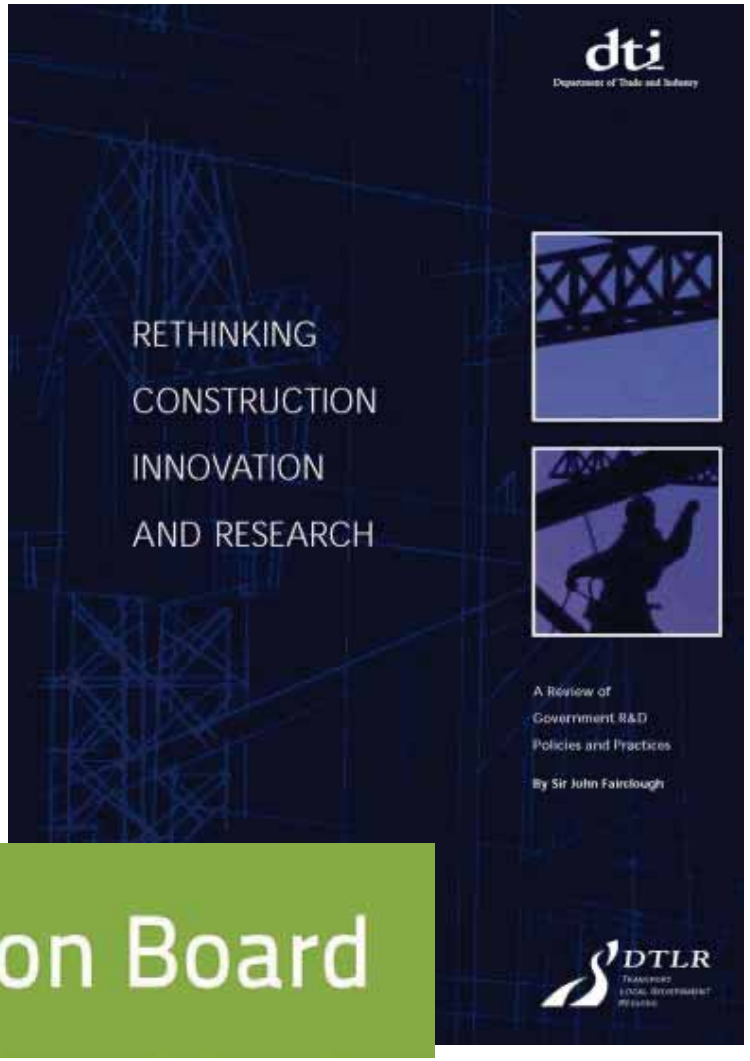
SO WHERE IS GOVERNMENT'S INSTITUTIONAL MEMORY TODAY?

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

As a result, policy relies too much on hope, predictions and lobbies; and less on lived experience of what works and what really needs attending to.

Instead of responding to early signals, often it only reacts to crises.

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



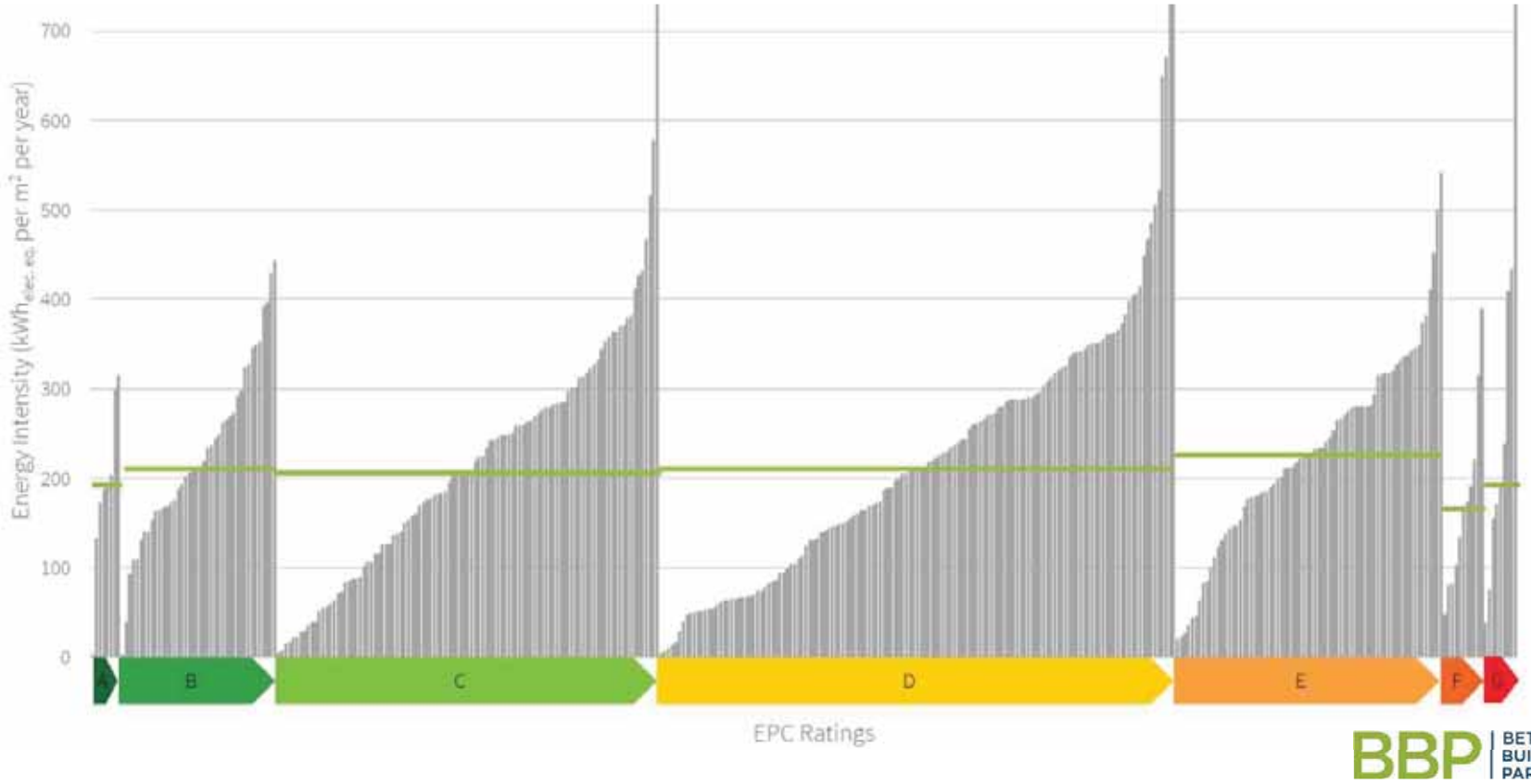
The Green Construction Board

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

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, Oct 2025

Department for Energy Security & Net Zero

Ofgem

"92% of EWI and 27% of IWI non-compliant
6% of EWI and 3% of IWI risk occupant health"

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

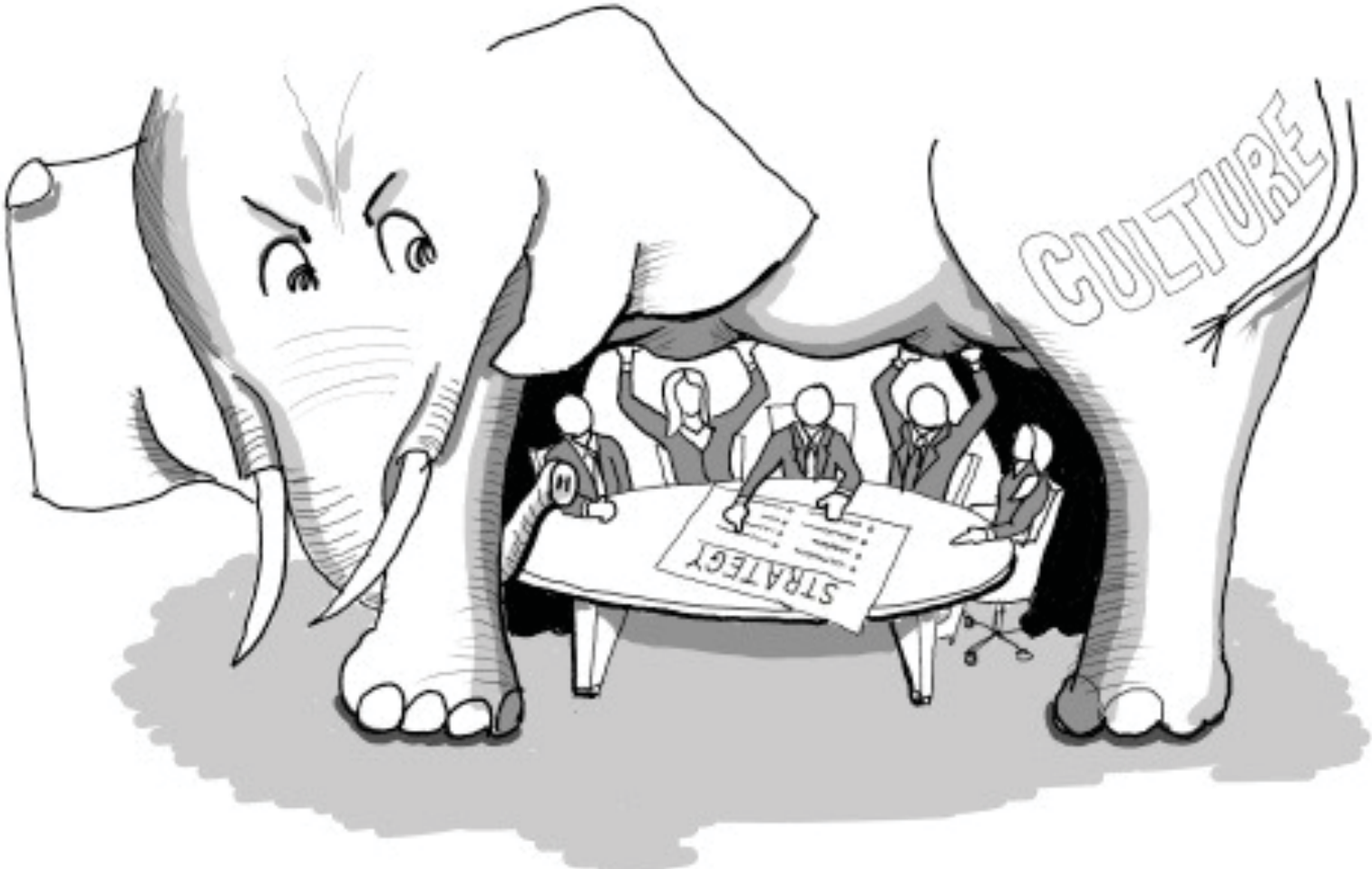
Print this page

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

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

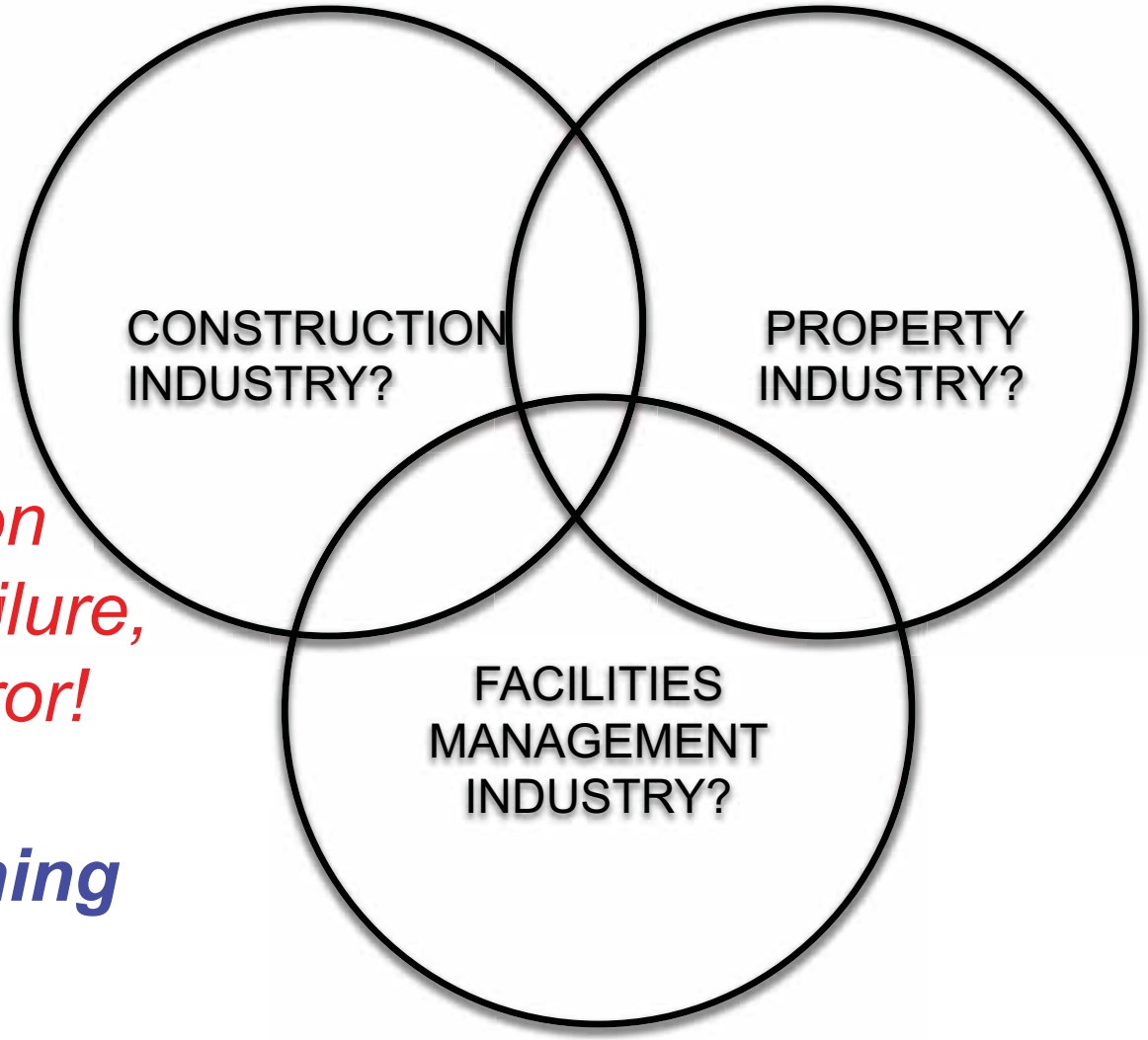
SOURCE: Bruce Flye, 2012, www.bruceflye.com/concept-graphics/illustrations/4092610

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 …



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 OF BUILDINGS IN USE

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).

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

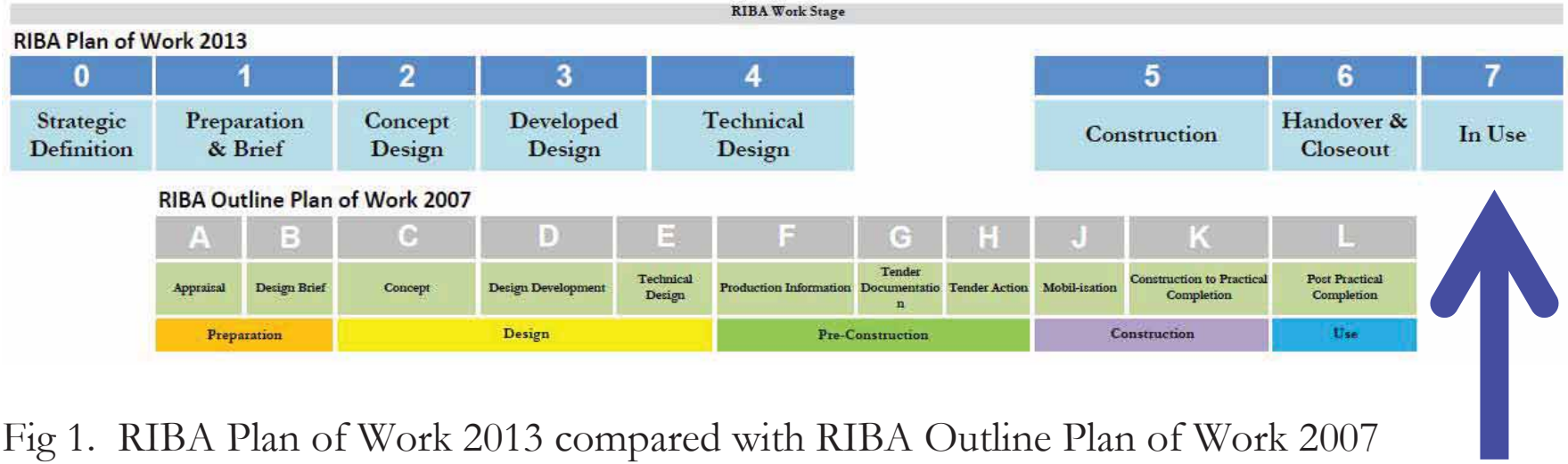


Fig 1. RIBA Plan of Work 2013 compared with RIBA Outline Plan of Work 2007

And some universities are becoming more active – but many still not.

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

"We design to the rules, not for good outcomes" - ENGINEER

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

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 per se*

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

The need for culture change is now becoming explicit *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

TO CITE THIS ARTICLE:
Foxell, S. (2025). Built environment governance and professionalism: the end of *laissez-faire* (again). *Buildings and Cities*, 6(1), pp. 767–782. DOI: https://doi.org/10.5334/bc.713

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

PART 4

IMPLICATIONS FOR PROFESSIONS and PRACTICE

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

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?

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

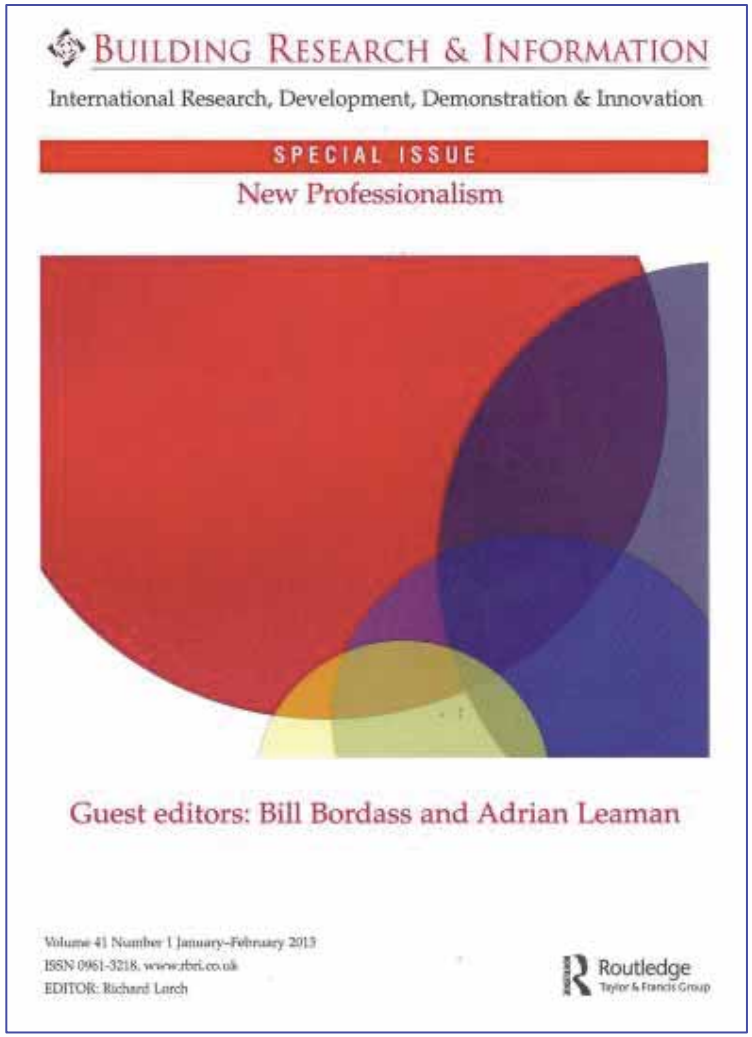
and can establish hypotheses that can be tested elsewhere.

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

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 !**

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.

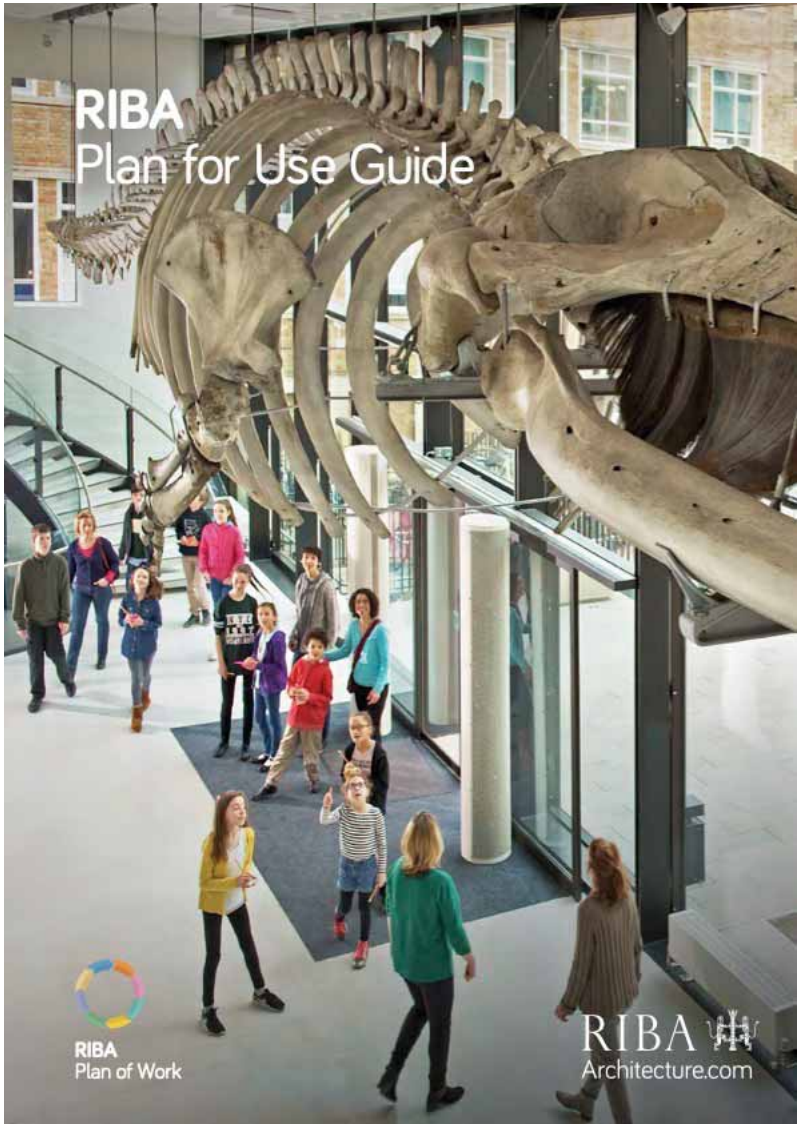
THE WIDER CONTEXT:

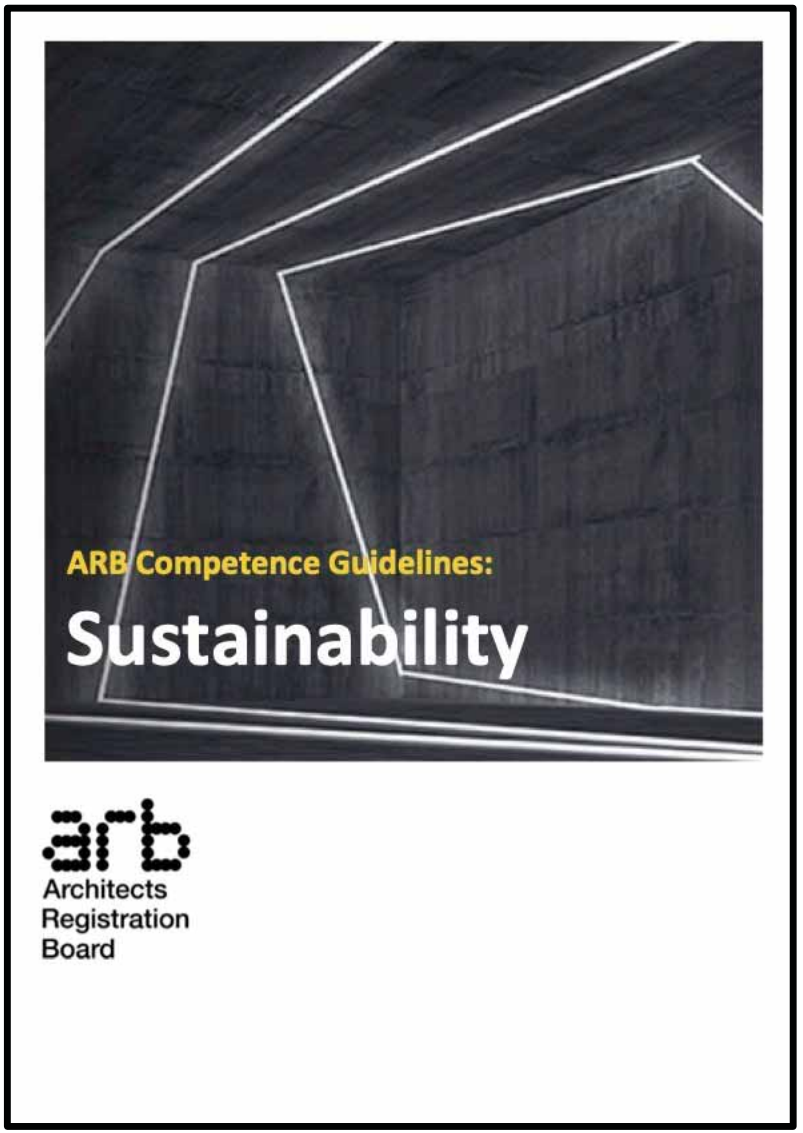
8. Seek to bring together practice, industry, education, research and policymaking.
9. Challenge assumptions and standards. Be honest about what you don't know.
10. Understand contexts and constraints. Create lasting value. Keep options open for the future.

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

Recent architectural responses: *Apr+Aug 2021*

Preceded by the RIBA Sustainable Outcomes Guide (2019)





SOURCE of RIBA's Plan for Use and related material: riba.org/work/insights-and-resources/plan-for-use-guide/

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

Soft Landings and routine 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!*

PART 5

THE VALUE ROUTINE
POE and BPE CAN BRING

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

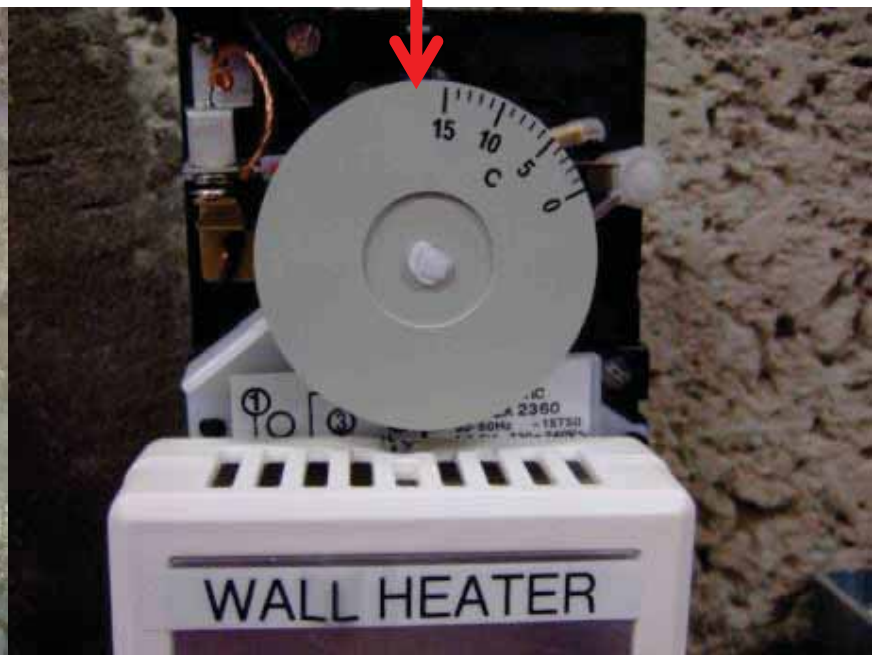
Edited by Mike Buckley, Bill Bordass and Roderic Bunn

BSRIA BG 9/2010

SOFT LANDINGS

Research funded by
Technology Strategy Board

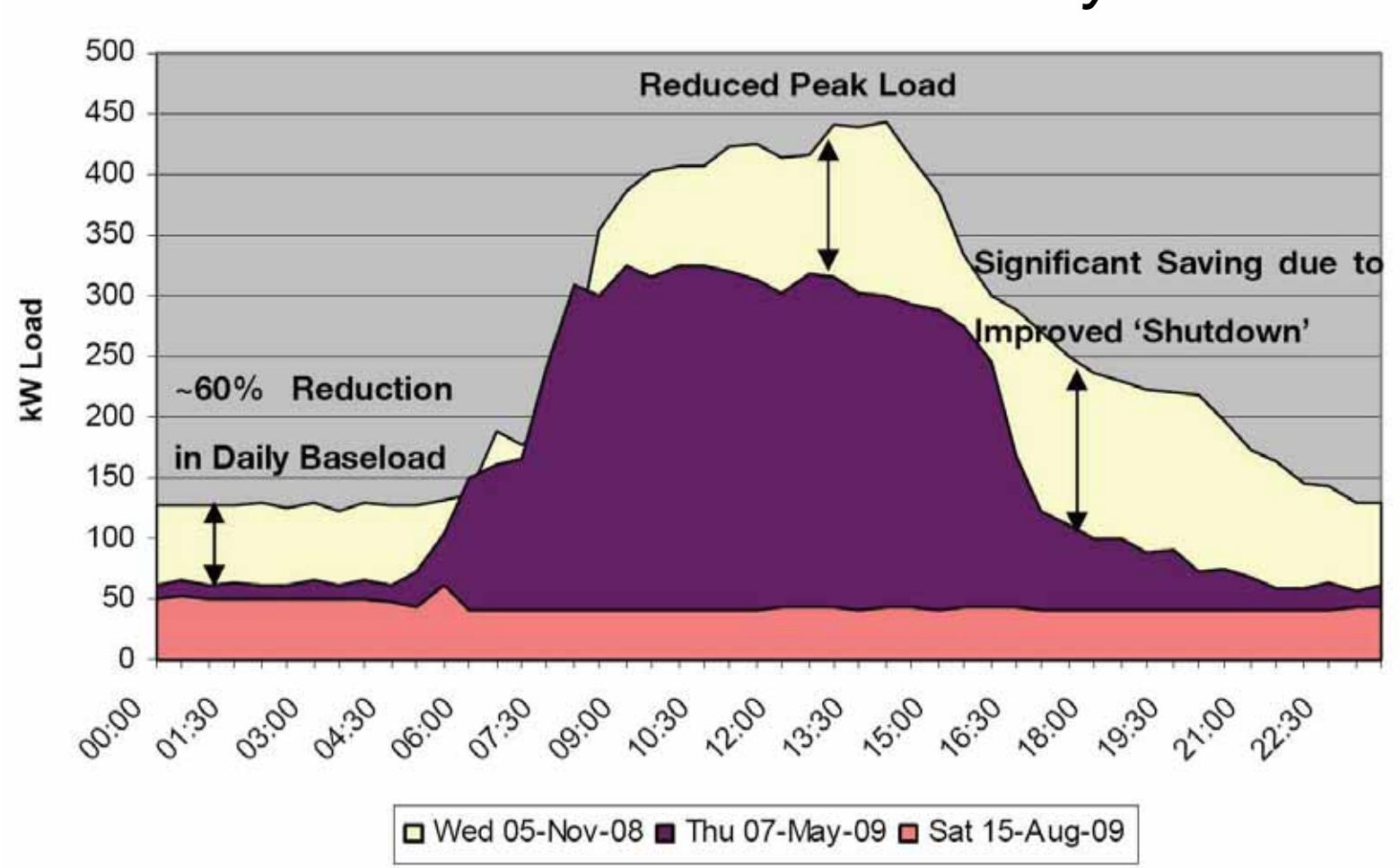
Aftercare can trap unintended consequences:
Example: sprinkler frost protection in a primary school



In 2008-09, this “tamperproof frost thermostat *(improperly set at 17° C)* 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.

Aftercare management will often pay 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).

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

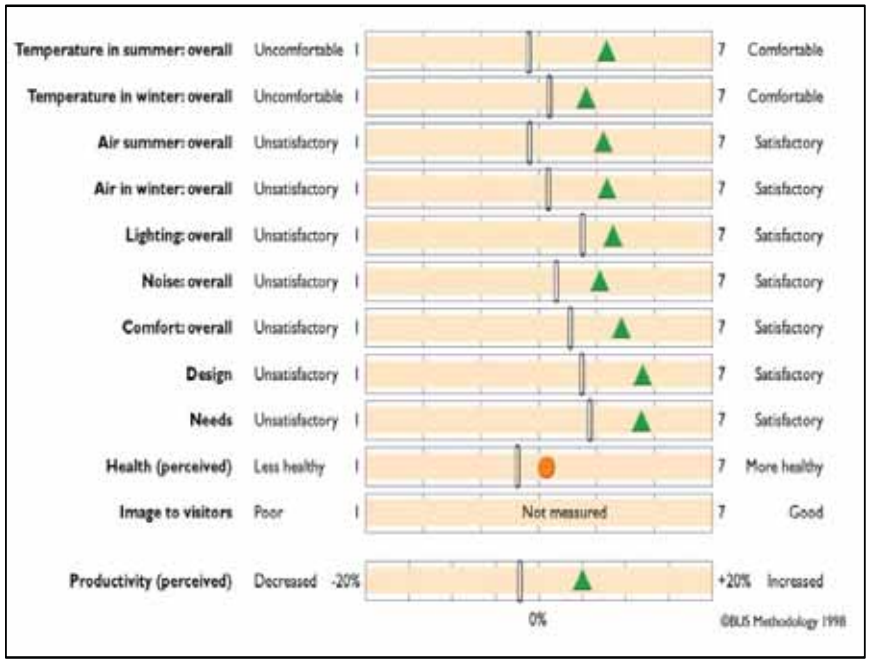
- Improved, custom design
- Better located
- Not yet perfect

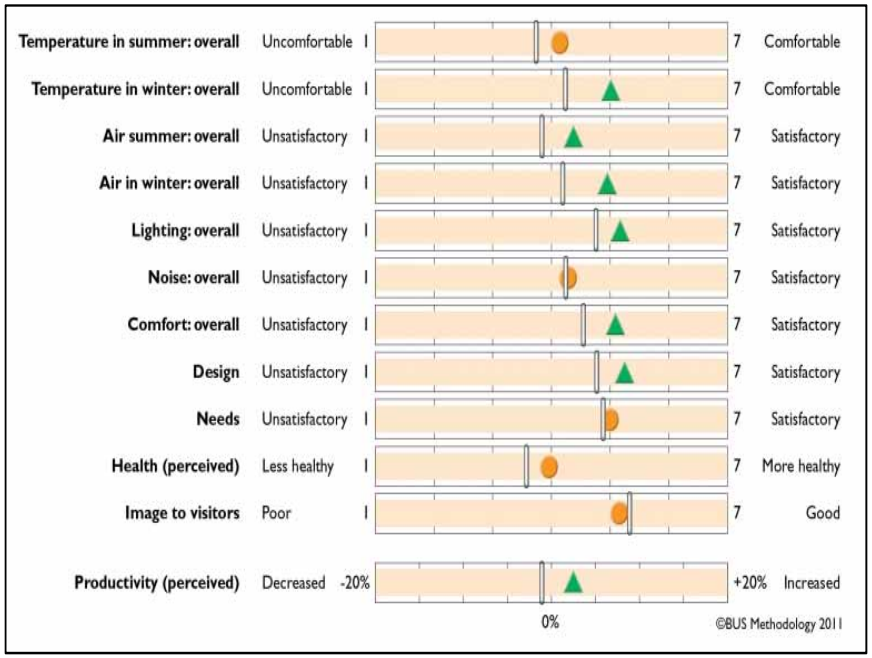
Feeding forward between projects:
National Trust to Woodland Trust

For further reading, see B Bordass et al, *Trees of Knowledge,* CIBSE Journal 20-26 (Oct 2014). Download at usablebuildings.co.uk

Revisiting projects: *Longitudinal surveys*

1998 *BUS Occupant questionnaire* ***2011***





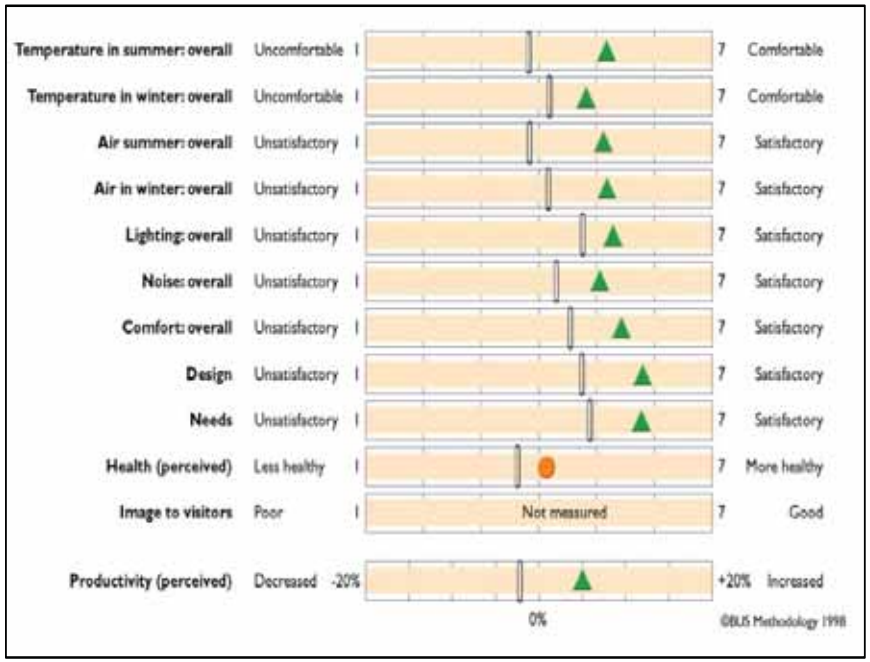
Average scores from BUS occupant survey questionnaire:
Vertical bars = benchmark medians from similar buildings.
Green triangles = significantly better than benchmark.
Orange circles = indistinguishable from benchmark, Red squares = worse

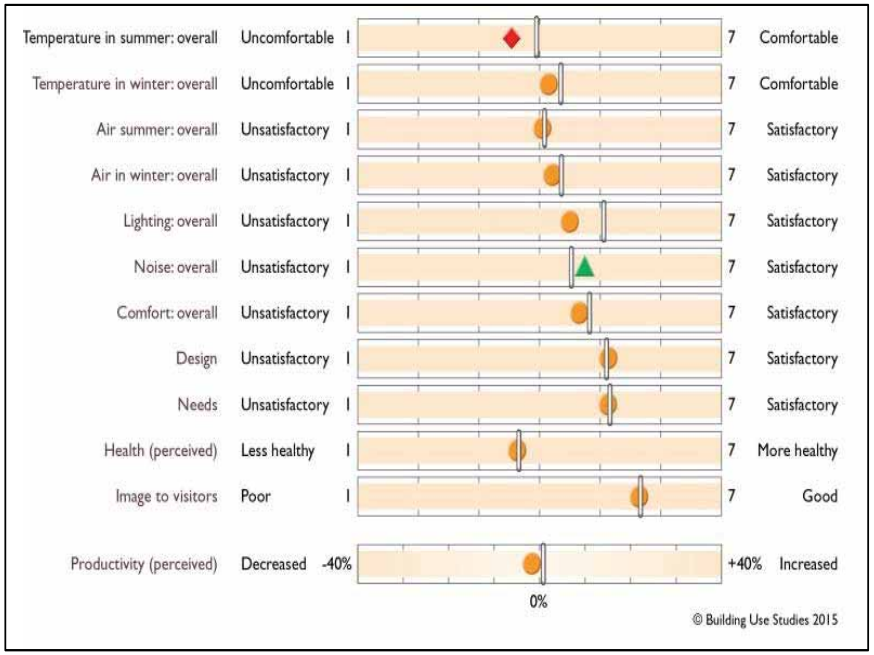
Some degradation over the years, but recognisably similar

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

Revisiting projects: *Longitudinal surveys*

1998 *BUS Occupant questionnaire* ***2015***





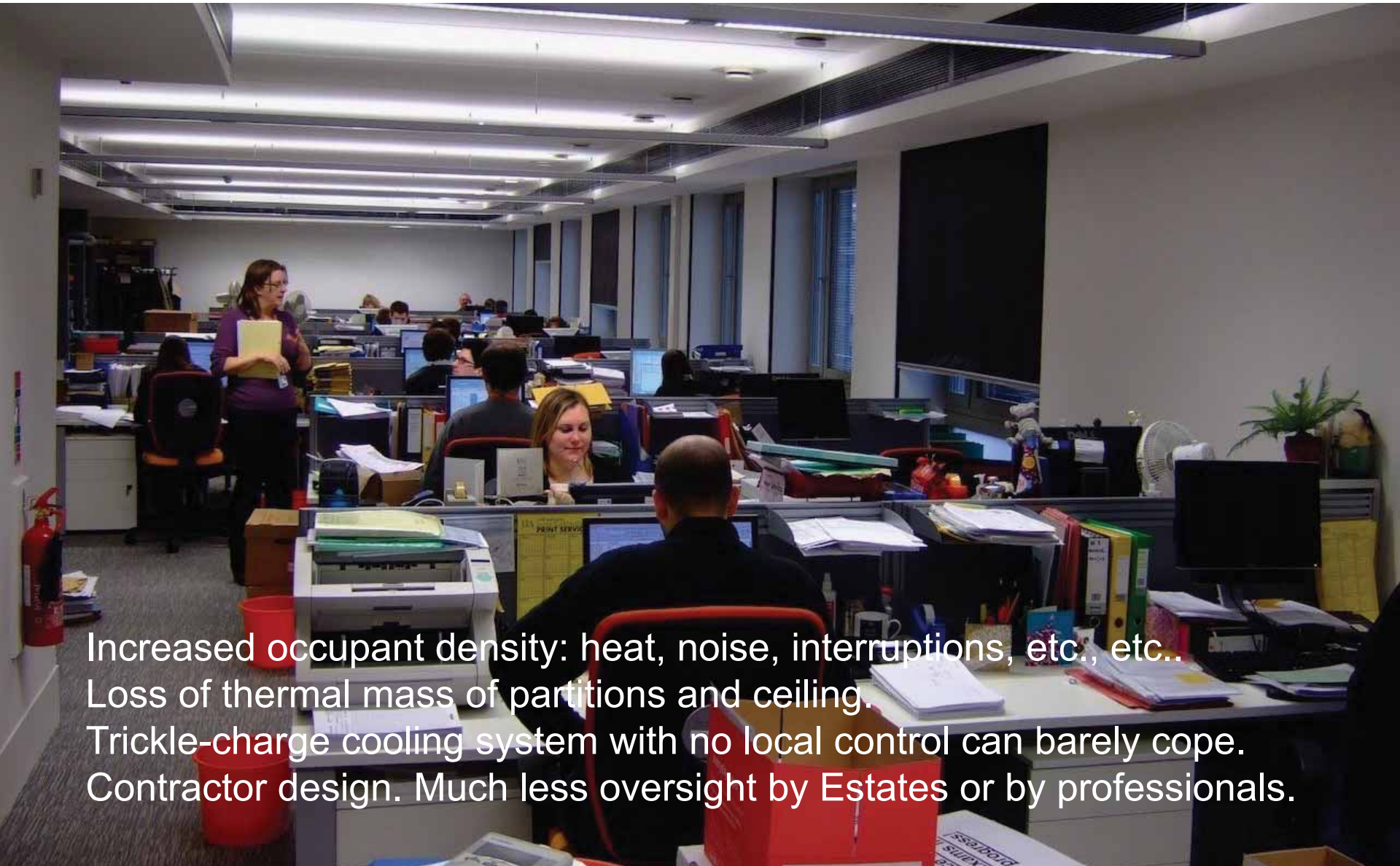
Average scores from BUS occupant survey questionnaire:
Vertical bars = benchmark medians from similar buildings.
Green triangle = significantly better than benchmark.
Orange circle = indistinguishable from benchmark, Red diamond = worse.

Now very much average – *WHAT HAPPENED ?*

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

The building and its use was altered

particularly ca. 2012: this was once four seminar rooms



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. Much less oversight by Estates or by professionals.

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.

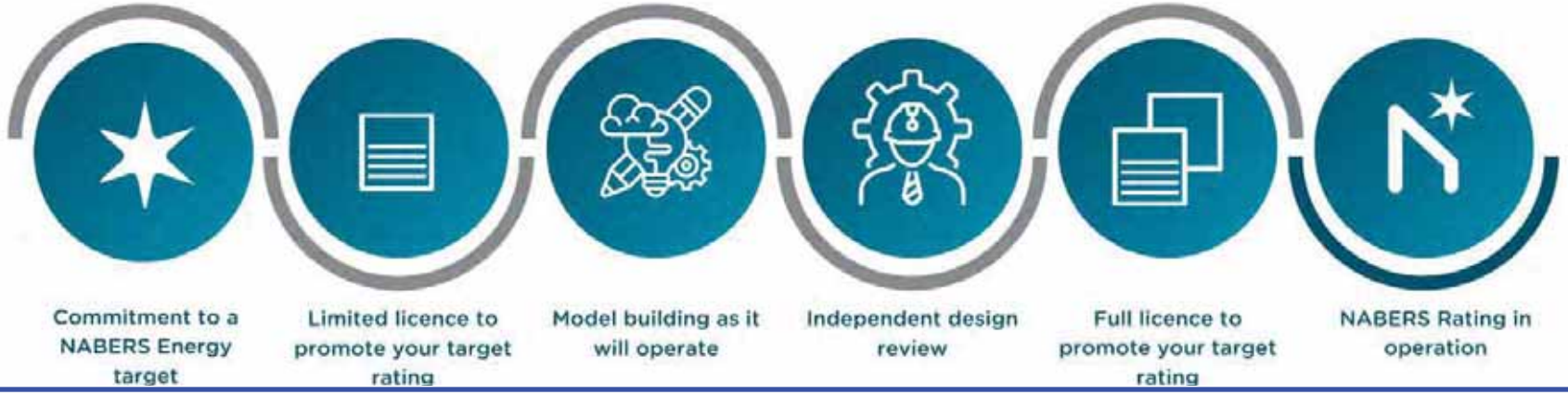
The energy efficiency of new offices in the UK is subject to Building Regulations Part L and represented in market transactions by Energy Performance Certificates (EPCs). Developers, owners and occupiers of new and refurbished buildings might reasonably expect that these mechanisms will produce a building 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

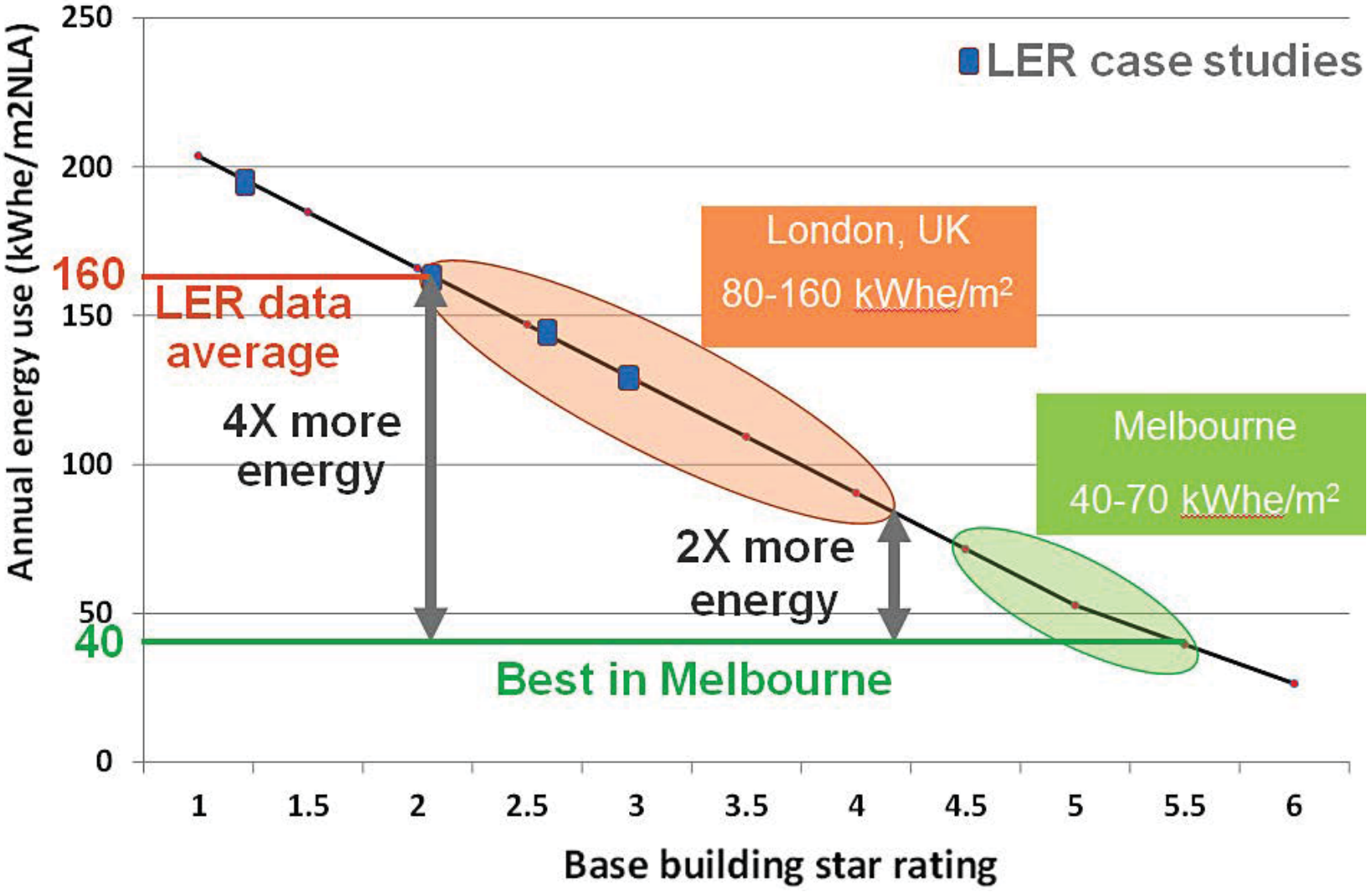
Design for Performance CAs - *Commitment Agreements, as developed by NABERS in Australia*

- 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? **Nov 2025**

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.

The first UK office with measured in-use operational performance in accordance with its design intent.

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

PART 6

HOW MIGHT ALL THIS AFFECT LOW-CARBON RETROFITS?

Should we be resolving our problems, *or re-examining our premises?*

"We can't solve problems by using the same kind of thinking we used when we created them"

Attributed to A EINSTEIN

"We are suffering from an attempt to know our way into the future, instead of live our way"

W SHARPE

"Altogether, we are failing to deliver, and I think the whole political system is responsible"

LORD DEBEN

SOURCES: Bill Sharpe, *Three Horizons: the patterning of hope,* Triarchy Press (2020), Lord Deben: *https://www.politicshome.com/thehouse/article/altogether-failing-deliver-chair-climate-committee-lord-deben-warns-dangers-climate-inaction#:~:text="Altogether%20we%20are%20failing%20to,is%20responsible%2C"%20he%20says.*

RETROFIT-RELATED RESEARCH: Some personal lightbulb moments: 1

1970s Non-domestic energy surveys:
Lots of scope for simple, user-friendly measures.

1980s Historic buildings: *Importance of moisture.*

Non-domestic retrofit: *Emergence of performance gaps, unmanageable complication, lack of even simple monitoring.*

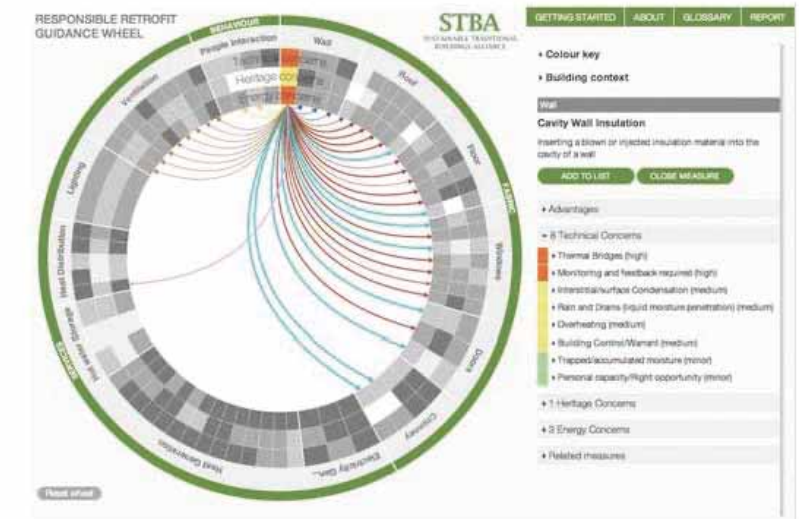
1990s Non-domestic POEs: *Deficiencies in building procurement, over-optimistic energy prediction, few tune-ups.*

Singapore fabric first refit edict: *could **increase** office energy.*

2000s Traditional domestic retrofit:
Owner-occupiers often cut corners successfully. Social landlords couldn't, but their solutions risked being fragile.

2010s Domestic Green Deal: *Only an energy shopping list, so we helped to develop the STBA Guidance Wheel.*

Performance 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

RETROFIT-RELATED RESEARCH: Personal lightbulb moments: 2 - Recent

In particular from work on PAS 2038 and the Heritage group of the developing UK Net Zero Carbon Buildings Standard.

- BS PAS 2035 and 2038 concentrate on ”Medium Term” retrofit plans. These are too expensive for many clients and can ignore many opportunities and constraints. *We need a better briefing process.*
- Owner-occupiers, Social landlords and Private landlords have very different perspectives. *So do rich and poor.*
- Most owner-occupiers will proceed incrementally.
- Planning authorities can be a big problem: *“Conservation Officer says no”.* Education required.
- Retrofit provides opportunities to reverse indignities inflicted on traditional buildings, *see for example the ACAN Guide*.*
- Most designers and builders know little about traditional buildings.
- Local knowledge is vital. *Do things bottom-up not top-down.*

* ACAN Conservation Area Toolkit, Architects Climate Action Network (March 2023)


CHANGED
PRIORITIES
AHEAD
WOOSTER

Priorities for existing buildings: FABRIC FIRST?

Essential to think about for new construction, *as the fabric tends to be the most difficult to change later.*

HOWEVER

- Most post-WW2 buildings were not well designed or built in terms of the fabric's environmental performance.

AND

- Existing buildings can be sensitive, both aesthetically, and in terms of technical performance. TAKE CARE!
- Interventions can be destructive, particularly those that add layers and increase vulnerabilities, e.g. to moisture-related problems, fire and recovery from floods.
- Fabric first means GOOD MAINTENANCE FIRST: *Too often this has not happened (viz the Green Deal).*

Scope for massive improvement

if you use the multiplier effect. For example:

BE LEAN - Halve the demand

Review standards, reduce losses, avoid waste.

times

BE MEAN - Double the efficiency

Buy efficient equipment, use it efficiently, avoid system losses, tune it all up.

times

BE GREEN - Halve the carbon in the supplies

With on-and off-site measures

equals

You're down to one-eighth of the CO_2

BUT YOU NEED TO TAKE ALL THE STEPS!

PROPORTIONATE RETROFIT:
A spectrum of approaches to suit the purpose

TYPE	**COMMENT**	**TYPICAL COST** *(per dwelling)*	**SOME INGREDIENTS**	**NOTES**
1. DEEP RETROFIT *LETI Exemplary*	The mantra? e.g. EnerPHit, at least until recently.	£ 100,000	Full suite of measures.	Nice work if you can get it, but rare.
2. GOOD PRACTICE *e.g. AECB*				
3. COST EFFECTIVE AT SCALE				
4. "SOFT" RETROFIT *People first*				
5. BASIC ENERGY SAVING				

REFERENCE for Level 3: Retrofit at Scale: A call to action (2024), https://sdfoundation.org.uk/news/retrofit-at-scale

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3. COST EFFECTIVE AT SCALE *(but needs R, D&D, on process too)*	Pareto optimum? *80% of the way with 20% of the money.*	£ 20,000	Pragmatic fabric *to halve annual heat requirement from current 130 kWh/m^2 median.*	Might include highly simplified MVHR and ASHP.
4. "SOFT" RETROFIT *People first*				
5. BASIC ENERGY SAVING				

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3. COST EFFECTIVE AT SCALE *(but needs R, D&D, on process too)*	Pareto optimum? *80% of the way with 20% of the money.*	£ 20,000	Pragmatic fabric *to halve annual heat requirement from current 130 kWh/m^2 median.*	Might include highly simplified MVHR and ASHP.
4. "SOFT" RETROFIT *People first*	A rather different mindset. ***More about this later.***	£ 5,000 or less	Work out to the fabric, rather than in from it. *Useful for heritage.*	Quick and simple, but novel ingredients
5. BASIC ENERGY SAVING				

REFERENCE for Level 3: Retrofit at Scale: A call to action (2024), https://sdfoundation.org.uk/news/retrofit-at-scale

PROPORTIONATE RETROFIT:
A spectrum of approaches to suit the purpose

TYPE	COMMENT	TYPICAL COST *(per dwelling)*	SOME INGREDIENTS	NOTES
1. DEEP RETROFIT *LETI Exemplary*	The mantra? e.g. EnerPHit, at least until recently.	£ 100,000	Full suite of measures.	Nice work if you can get it, but rare.
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5. BASIC ENERGY SAVING	Simple, *but too often still not done.*	£ 1,000 or less	Basic insulation, draughtproofing, control etc.	Retrofit plans often miss this. *Advisers needed!*

REFERENCE for Level 3: Retrofit at Scale: A call to action (2024), https://sdfoundation.org.uk/news/retrofit-at-scale

So what can we now do quickly *to be healthy and comfortable enough while saving energy in a hurry?*

Comfort is socially and culturally determined:

People's needs… have social histories of their own … The [mistaken] distinction between technology … and behaviour.

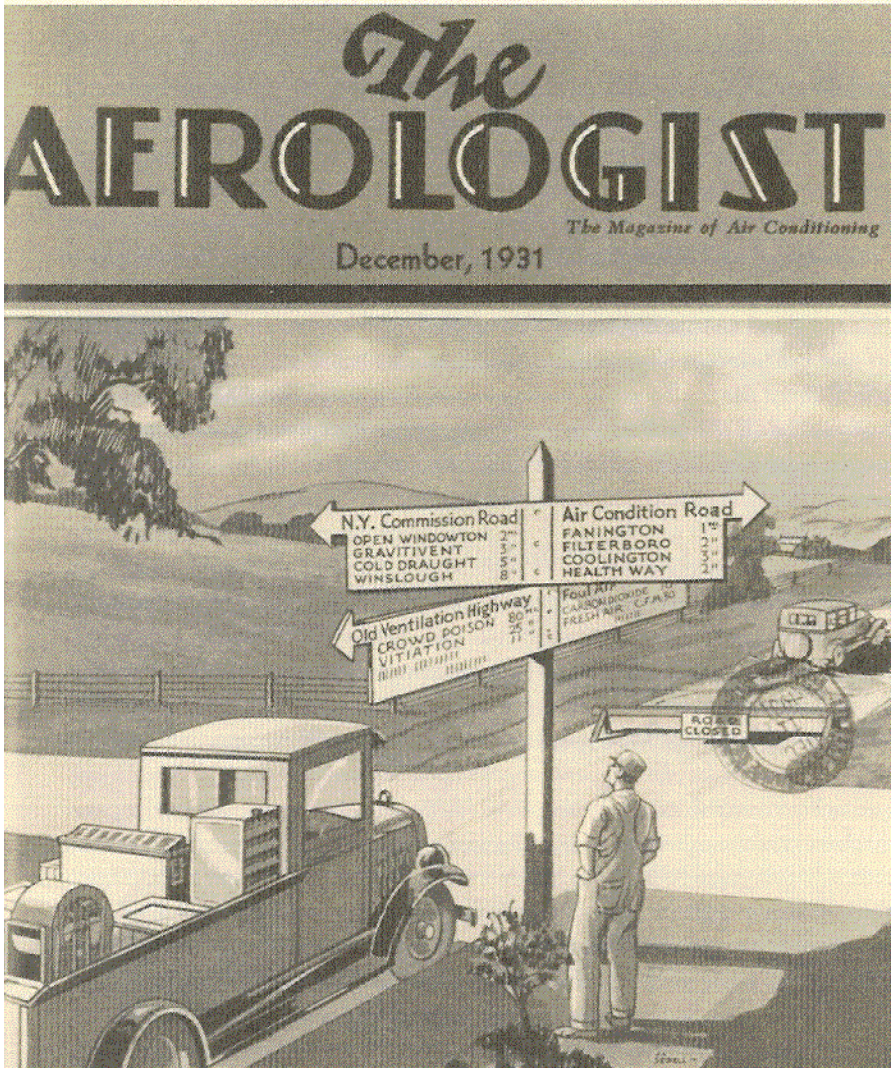
"Sociology … repeatedly demonstrates the extent to which things … 'script' what people do …

"If current understandings of comfort underpin escalating energy demands, why persist with them?"

SOURCE: E Shove, *Why social theory is important for energy research and the built environment,* Buildings & Cities (14 Sep 2020).

FRAMING COMFORT *in the 20th Century:*

Space conditioning was converted into a marketable commodity



"In 1922, the New York State Commission … advocated natural ventilation … The engineering community seriously opposed …

… "The Aerologist journal … argued physicians were stepping outside their [professional] boundaries.

"When natural climate was the ideal, mechanical systems were found wanting, but when quantitative standards … became the measure, natural climate was found wanting. When no town could deliver an ideal climate, ***all towns became potential markets."***

AND AFTER WORLD WAR 2:

Climate-responsive features of buildings (verandahs, shutters, shade roofs etc.) were simplified or eliminated, in order to make air conditioning more affordable.

SOURCE: G Cooper, *Air-conditioning America,* Johns Hopkins University Press (1998), pages 69-79 and cover illustration.

Lobbying Rules OK?

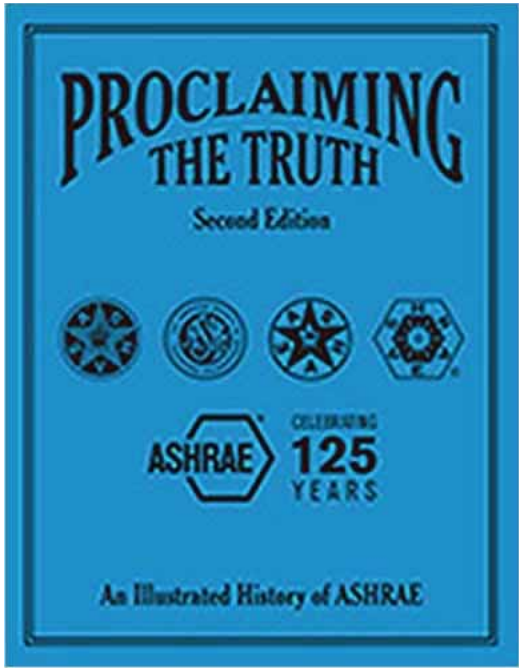
Constitution of American Society of H&V Engineers 1895

To establish a clearly defined minimum standard of heating and ventilation for all classes of buildings.

To favor legislation compelling ventilation of all public buildings in accordance with the standard of this society.

To encourage legislation favorable to improvement in the arts of heating and ventilation, and

to oppose legislation inimical to the business of the engineer.



SOURCE: ASHRAE, *Proclaiming the Truth,* American Society of Heating, Ventilation and Air Conditioning Engineers (2020), page 3

ENERGY SUFFICIENCY: *Avoid unhealthy environments, allow escape from crises of discomfort*

MAIN METHODS:

1. Review appropriate standards *and promote adaptive comfort*
2. Control draughts, air movement and radiant heat gains and losses
3. Wear the right clothing and have suitable furniture etc.
4. Consider local and personal heating and cooling systems
5. Have accessible, responsive user-friendly controls
6. Improve thermoregulatory fitness where practicable
7. ADD thermal refuges, *both hot and cold, local and communal.*
8. *Plan to avoid health and moisture-related unintended consequences.*

"He gets so dramatic when I lower the thermostat."

These also save energy and carbon much more quickly and cheaply than heavy capital investment.

P C Vey cartoon from the New Yorker (1 April 2019).

Recent research results:
from a people-first co-creation project in Belgium

New insights into thermal comfort sufficiency in dwellings

GEOFFREY VAN MOESEKE
DENIS DE GRAVE
AMÉLIE ANCIAUX
JEAN SOBCZAK
GRÉGOIRE WALLENBORN

BUILDINGS & CITIES
SPECIAL COLLECTION: ENERGY SUFFICIENCY IN BUILDINGS AND CITIES
RESEARCH
ubiquity press

SOURCE:*https://jo urnal-buildingscities.org/articles/10.5334/bc.444*

Recent research results:
from a people-first co-creation project in Brussels

- 3-year project with 23 households.
- Co-creation of measures: householders, meetings, researchers.
- Mean indoor temperatures fell from 19 to 15 C.
- Main adaptations were clothing and personal comfort systems (PCSs).
- PCSs were used less as the project continued – *we have found this in other projects** – *when people know they have the agency to avoid a "crisis of discomfort", they become more tolerant of conditions.*
- Energy consumption for heating was halved.
- No increase in electricity consumption overall.

"The widespread use of central heating may be suspected of inhibiting other forms of adaptation"

SOURCE: *https://journal-buildingscities.org/articles/10.5334/bc.444*

Learning to sail a building: a people-first approach to retrofit

BUILDINGS & CITIES

SPECIAL COLLECTION: NET ZERO RETROFIT OF THE BUILDING STOCK

RESEARCH

BILL BORDASS
KATIE STEELE
ROBYN PENDER
AMY GRAHAM

*Author affiliations can be found in the back matter of this article

ubiquity press

ABSTRACT

To decarbonise the built environment, it is widely assumed that 'fabric-first' building upgrades are essential. An alternative, people-first approach is proposed that could deliver energy and carbon reductions at scale and speed. The approach begins by re-examining some rarely questioned assumptions around historical practices and building science. Physics and thermal physiology can inform a reassessment of the causes of

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bill@bordass.com

Source: https://doi.org/10.5334/bc.572

People-first projects underway:
in Yorkshire, in 90 churches and 10 houses

SOFT RETROFIT: Some possible implications for heating in traditional buildings

Possible advantages	**Caveats**
Fewer alterations required to fabric, reducing associated risks too.	Some improvements may nevertheless be appropriate, depending on context.
Lower internal air temperatures.	Sometimes they are too low already, *increasingly so with current price spike.*
Less necessary to limit air infiltration if air temperatures are lower.	Some draughtproofing may also be helpful, depending on context.
Could help to reduce condensation and moisture problems that can occur after draughtproofing etc.	Cooler buildings can be more prone to problems from any internally-generated moisture - needs removal at source.
Potentially much faster, cheaper energy savings than deep fabric retrofits.	New technology is often electric and used at peak times. Storage needed?
Local electric systems simpler and less intrusive to install than traditional HVAC	Additional, dispersed electric heating equipment might increase fire risks.
Local systems could be particularly useful in lightly-occupied buildings.	Less energy-saving potential in heavily- or densely- occupied buildings.

MOVING FORWARD: *Evolving Mindsets*

PAST *can persist, or revert*	**PRESENT** *C20-21*	**FUTURE?** *Later C21*
SUBJECT *of a Chief, King, Pope, Dictator, Putin …*	**CONSUMER** *I spend, therefore I am*	**CITIZEN** + COMMUNITY *both local and wider scales*
PRIESTHOODS *+ Guilds Professions Unions*	MARKETS: *Invisible Hand, or Corporate Takeover?*	COLLABORATIVES *with diverse skills*

Subject-Consumer-Citizen classification from: J Alexander & A Conrad, *Citizens,* Canbury Press, Kingston (2022).

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PRIESTHOODS *+ Guilds Professions Unions*	MARKETS: *Invisible Hand, or Corporate Takeover?*	COLLABORATIVES *with diverse skills*
BUILDINGS: BUILT TO LAST, Robust *With routine maintenance*	BUILT TO CONSUME *Demolish or retrofit old ones*	IMAGINATIVE RE-USE *Improving what we've got*
COMFORT: LOCAL PROVISION *& Thermoregulatory Fitness*	SPACE CONDITIONING *Commoditised comfort*	RESILIENCE, AVOIDING CRISES of DISCOMFORT plus Thermal Adaptation
ENERGY: CONSERVATION *Husbanding resources*	EFFICIENCY *But not necessarily saving*	SUFFICIENCY *Living within our means*

"… we are living the end of what could have seemed an era of abundance … of products of technologies that seemed always available … of land and materials including water" - EMMANUEL MACRON, 23 Aug 2022

MOVING FORWARD: *Evolving Mindsets*

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ENERGY: CONSERVATION *Husbanding resources*	EFFICIENCY *But not necessarily saving*	SUFFICIENCY *Living within our means*
RESEARCH: BASIC *And on-the-job learning*	ACADEMIC *Distanced from practice*	REAL-WORLD *Closely integrated with practice*

MOVING FORWARD: *Evolving Mindsets*

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SUBJECT	**CONSUMER**	**CITIZEN** + COMMUNITY *both local and wider scales*
		COLLABORATIVES *with diverse skills*
		BUILDINGS: IMAGINATIVE RE-USE *Improving what we've got*
		COMFORT: AVOIDING CRISES of DISCOMFORT *plus Thermal Adaptation*
		ENERGY: SUFFICIENCY *Living within our means*
		RESEARCH: REAL-WORLD *Closely integrated with practice*

"You don't waste time with reactionaries; rather you work with active change agents and with the vast middle-ground of people who are open minded" - DONELLA MEADOWS *

* Donella Meadows and Dianne Wright, *Thinking in Systems,* Chelsea Green Publishing (2008) page 4.

So which mindset might this have come from?

Current Story or Emerging Story?

"The opportunity for widespread behaviour change has been considered, with a cautious approach to expectations that occupants will be able to reduce thermostats without improvements to building fabric –

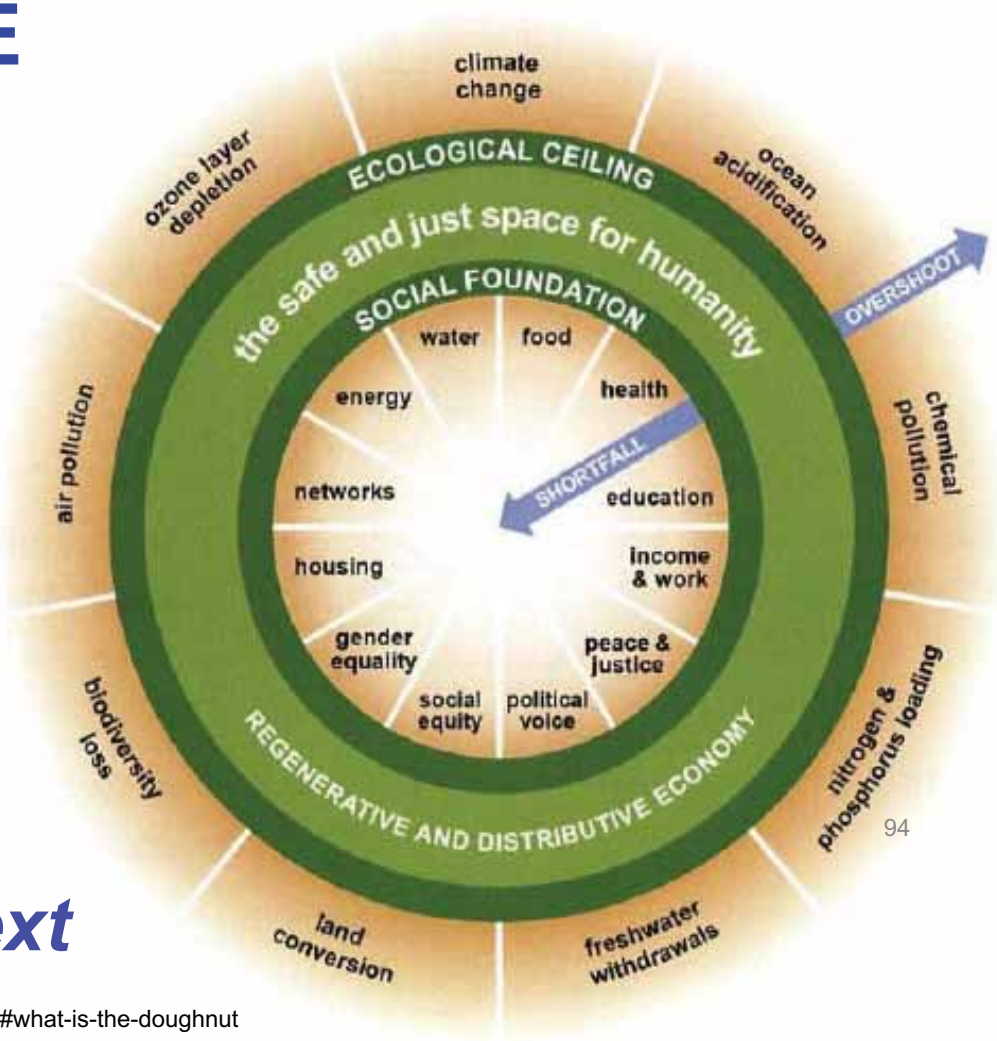
one of the supporting arguments for the fabric first* retrofit programme."

Net Zero Whole Life Carbon Roadmap

A Pathway to Net Zero for the UK Built Environment

* NOTE: this UK Green Building Council report (2021, page 24) also regards Fabric First as a "no regrets" strategy.

CLIMATE JUSTICE *and Doughnut Economics*



We need to seek the appropriate balance for a particular context

SOURCE: https://doughnuteconomics.org/about-doughnut-economics#what-is-the-doughnut

94

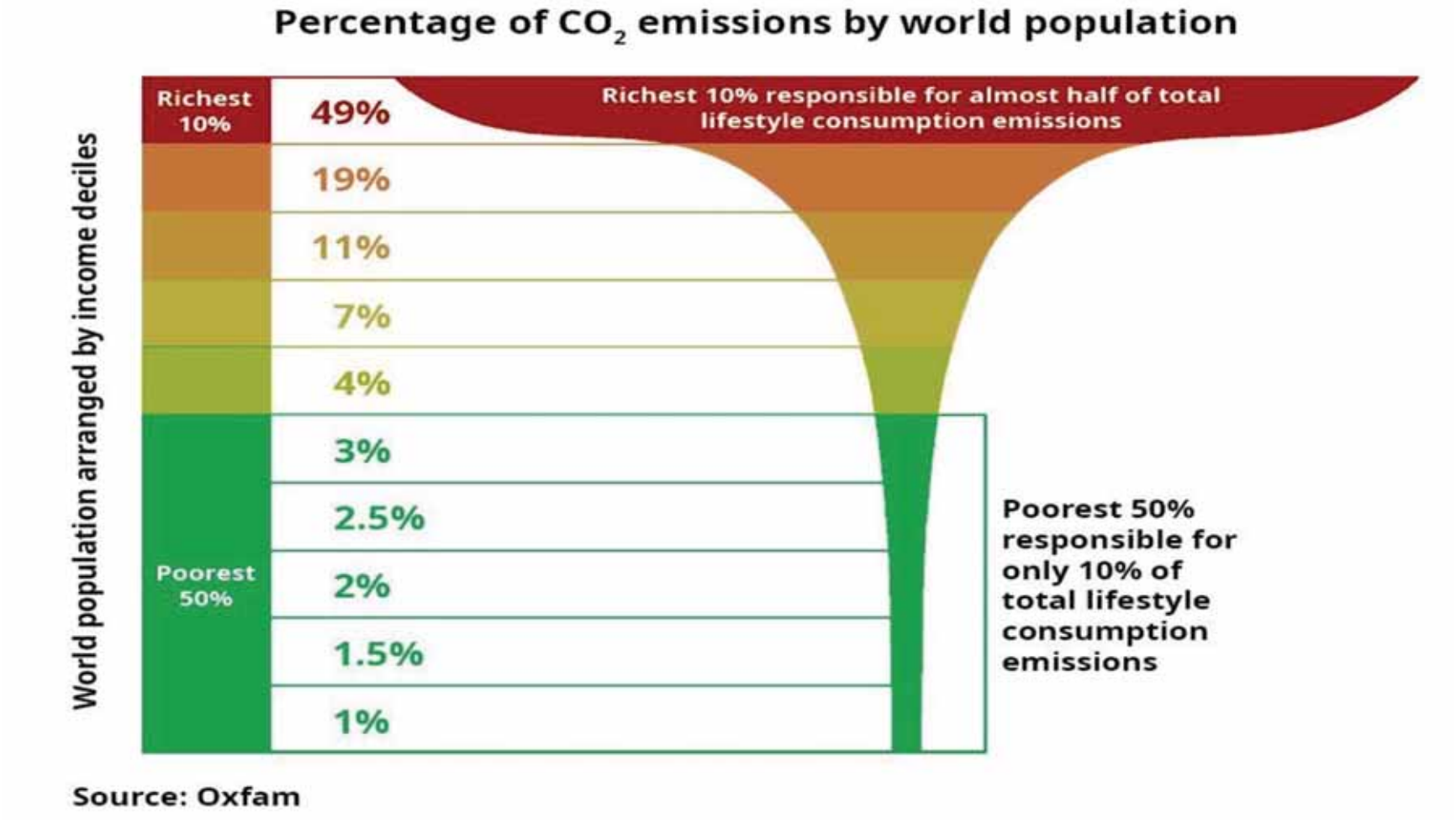
SOURCE: https://doughnuteconomics.org/about-doughnut-economics#what-is-the-doughnut

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 !

"A constrained world cannot afford the rich "
GEORGE MONBIOT

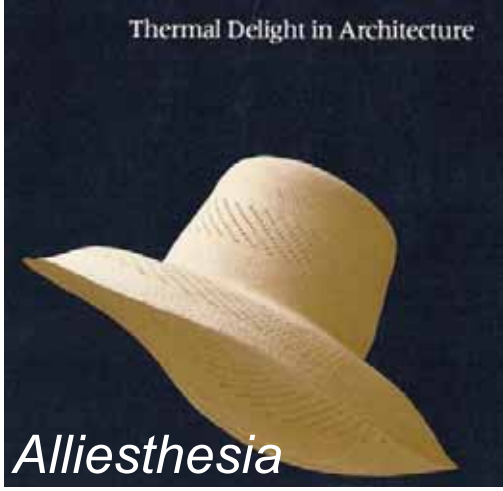


SUPPLEMENTARY SLIDES

NOT SHOWN ON THE DAY

BEYOND SPACE HEATING AND COOLING

Comfort and discomfort in context
on a simplified scale



- Acute medical problems *(e.g. heat stress, frostbite)*
- **Discomfort** and stress *(too much of a good thing)*
- Delight *(exhilarating stress: theatre, beach, skiing)*
- Comfortably unbalanced *(e.g. comfortably warm or cool)*
- **Neutral** *(comfortable)* – ***Typical aspiration*** *(but sensory deprivation?)*
- Slightly uncomfortable *but tolerable (boiled frog)*

CRISIS OF DISCOMFORT *(comes sooner if one lacks perceived control)*

- Irritably uncomfortable
- Increasing discomfort, until …
- Acute medical problems *(heat stroke, hypothermia)*

People don't need heating or cooling

BUT heat gains and loss must not be so high that our physiology can't keep core body temperature under close control AND take care to avoid chronic health issues, e.g. from damp and mould.

SOURCE OF TOP ILLUSTRATION: Cover of L Heschong, *Thermal Delight in Architecture,* MIT Press (1979)

FRAMING: People respond to Stories

Stories can alter radically … and then become taken for granted

OLDER STORIES *can persist, or revert*	**CURRENT STORIES** *C20-21*	**EMERGING STORIES ?** *Later C21*

"If current understandings of comfort underpin escalating energy demands, why persist with them?" **Comfort is socially and culturally determined**:

People's needs… have social histories of their own … The [mistaken] distinction between technology … and behaviour.

"Sociology … repeatedly demonstrates the extent to which things … 'script' what people do …

"[while] dominant paradigms remain … there are fewer references to non-technical barriers and more to sociotechnical change… practices not behaviours."

e.g. *Clothes like these could halve demand for space heating:* ***Could they be made fashionable? >>>>***

SOURCE: E Shove, *Why social theory is important for energy research and the built environment,* Buildings & Cities (14 Sep 2020).

FRAMING COMFORT *in a Climate Emergency:*

How about seeking to escape ***Crises of discomfort*** *

HOW?

Use perceived control & adaptive opportunity, e.g:

- Adjust a passive system *(windows, blinds etc).*
- Adjust M&E services *(central, local or personal).*
- Contact the manager *(but rapid response is vital).*
- Adjust posture, clothing, activity etc. *(+ lap dogs and hot water bottles)*
- Move about, go somewhere else, go outside *(possible at home, in some modern work environments, in Australia! …).*
- Eat or drink *(hot or cold), take a shower, feet in bucket* …

Loose control with adaptive opportunity can give greater occupant satisfaction with less energy dependency …

***BUT** achieving consensus in shared spaces can be tricky.*

* SOURCE: D Haigh, *User response in environmental control,* in D Hawkes & J Owers (ed), *The architecture of energy* (1981).

Where looser control works effectively
with occupants tending to report better conditions

- **Design intent is made clear** to occupants; and where possible is made intuitively obvious, *or at worst only needs explaining once.*
- **Controls are clear** to users and managers, and give them good feedback on what to do and what is then happening.
- **Default states (e.g. to OFF) are restored** manually or automatically, to avoid unnecessary stress and/or energy waste. *People are good judges of what they need, but can't have too much of a good thing.*

***AND IN MANAGED BUILDINGS**:*

- Facilities management is adequately resourced, respects users and responds rapidly and effectively to their needs.
- Organisations monitor performance in use, and make an effort to ensure that things are working and occupants are kept informed.

SOURCE: adapted from A Leaman & W Bordass, *Are users more tolerant of green buildings?,* BRI **35**(6), 662-73 (2007)

AVOIDING THERMAL DISCOMFORT

Beyond space heating and cooling

"Evening out fluctuations has become an egalitarian enterprise which it is heresy to question." - MICHAEL YOUNG

1. Challenge standards
2. Control draughts/breezes and radiant gains and losses
3. Effective clothing, *make it fashionable too.*
4. Local and personal heating *and appropriate furnishings*
5. Responsive, user-friendly controls, *default to off or safe*
6. Improve thermoregulatory fitness: *use it or lose it!*
7. Thermal refuges, *local and communal*

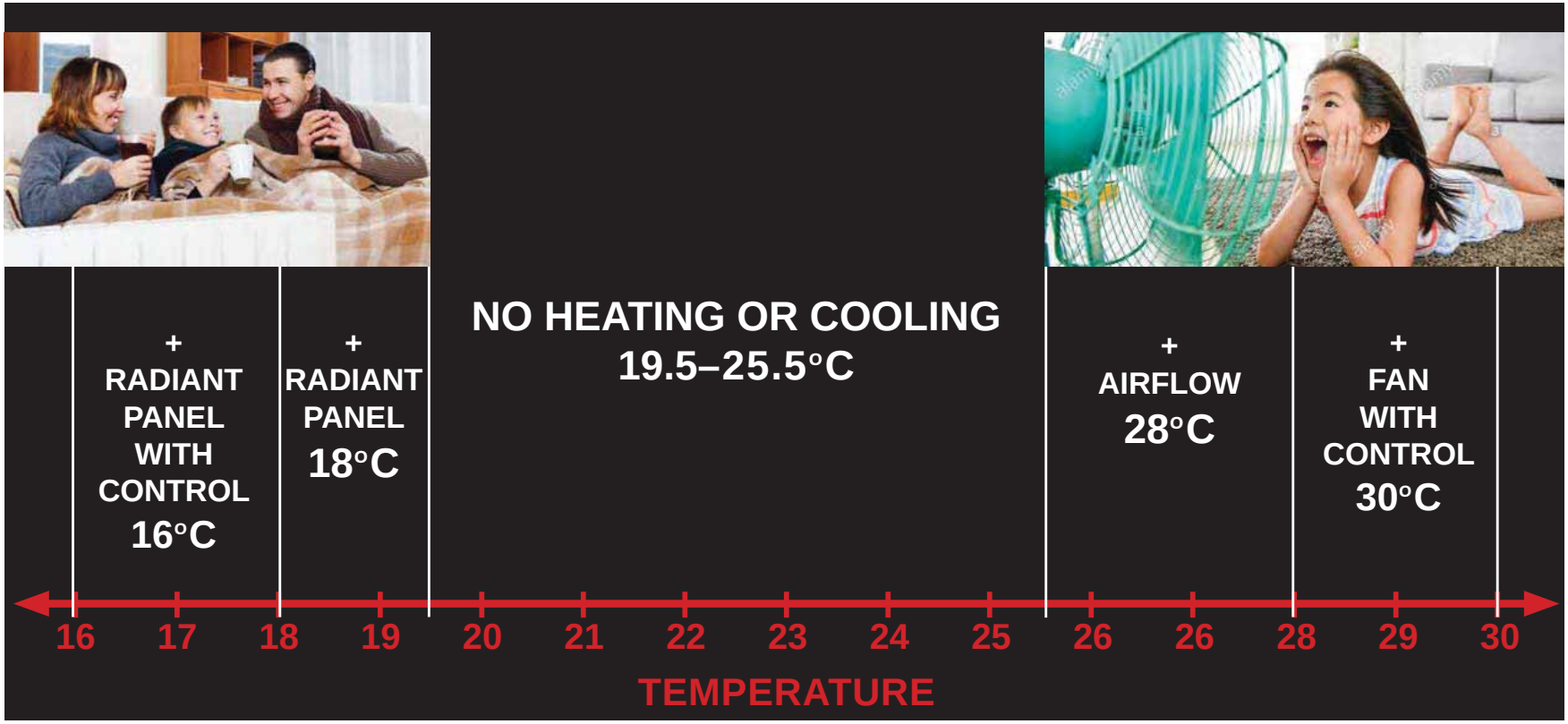
AND

8. Plan to avoid health-related unintended consequences.

MICHAEL YOUNG, *The Metronomic Society: Natural Rhythms and Human Timetables,* Thames & Hudson (1988)

1. STANDARDS: *Are they fit for today?*

What do we really need to heat and cool spaces to?



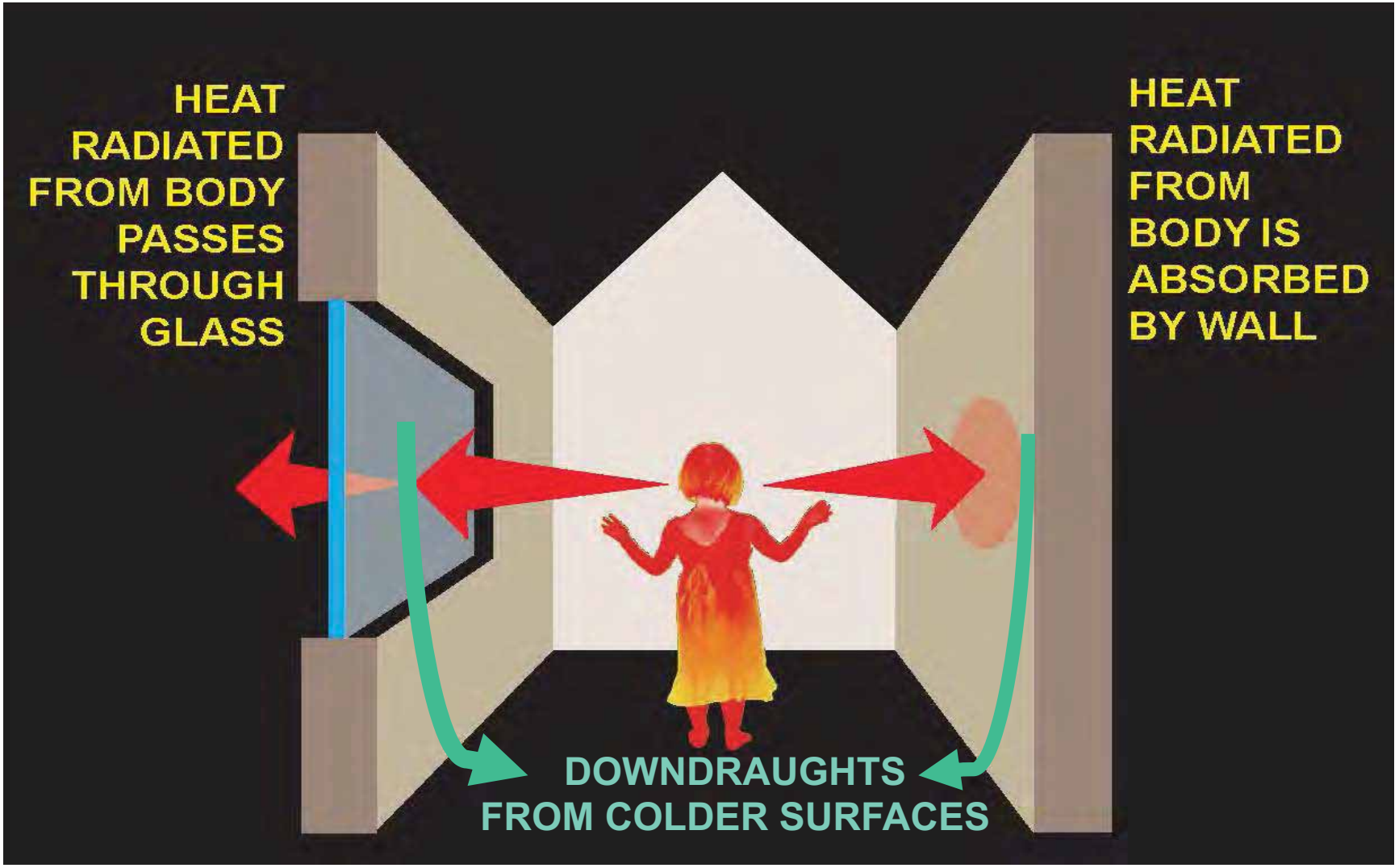
What about UK's recommended minimum 18° C Health requirement?

In its Minimum Home Temperature Thresholds review (2014)
Public Health England says it is a *"weak recommendation"* with little robust support,
but may be beneficial to the over-65s and those with pre-existing medical conditions.

SOURCE: R Pender (2019) after G Brager, *Evolving opportunities for providing thermal comfort,* Building Research & Information **43** 274-287 (2015).

2. DRAUGHTS & RADIATION:

Effects of relatively cooler surfaces



ADAPTED FROM: Robyn Pender, Historic England, *Lecture to the Rumford Club* (20 Feb 2020).

2. DRAUGHTS & “COLD” RADIATION:

Mediaeval hangings weren’t just decorative

SOURCE: Robyn Pender, Historic England, *Lecture to the Rumford Club* (20 Feb 2020).

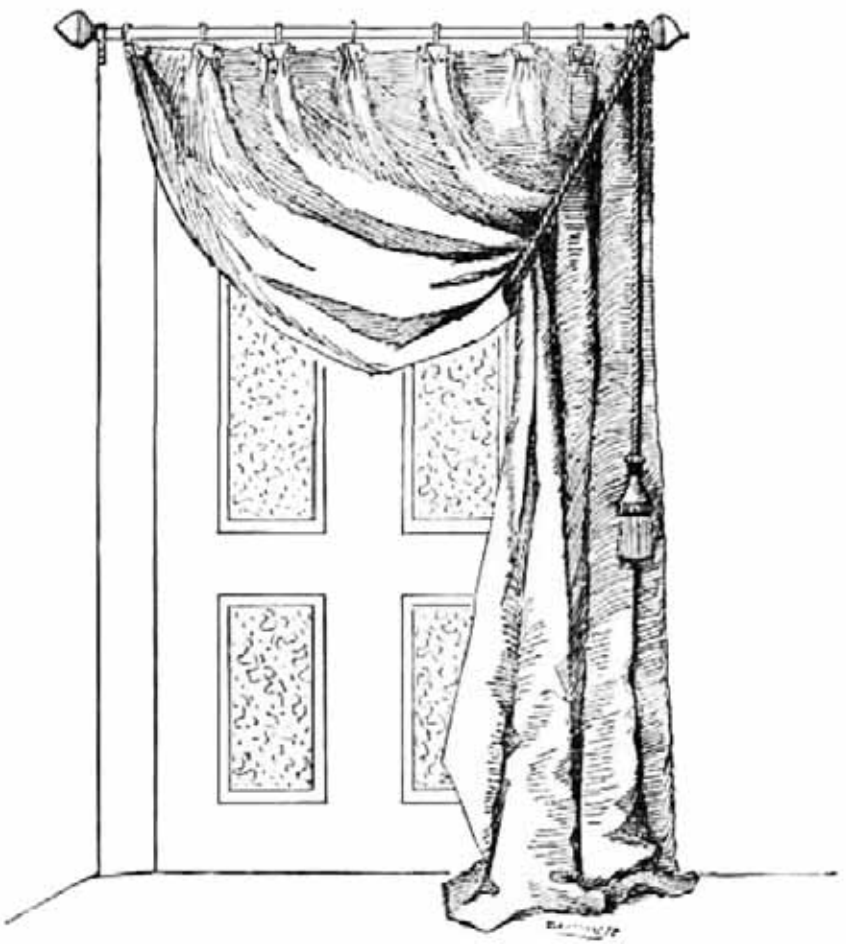
2. DRAUGHTS & "COLD" RADIATION:

Rich and poor could both have wall hangings

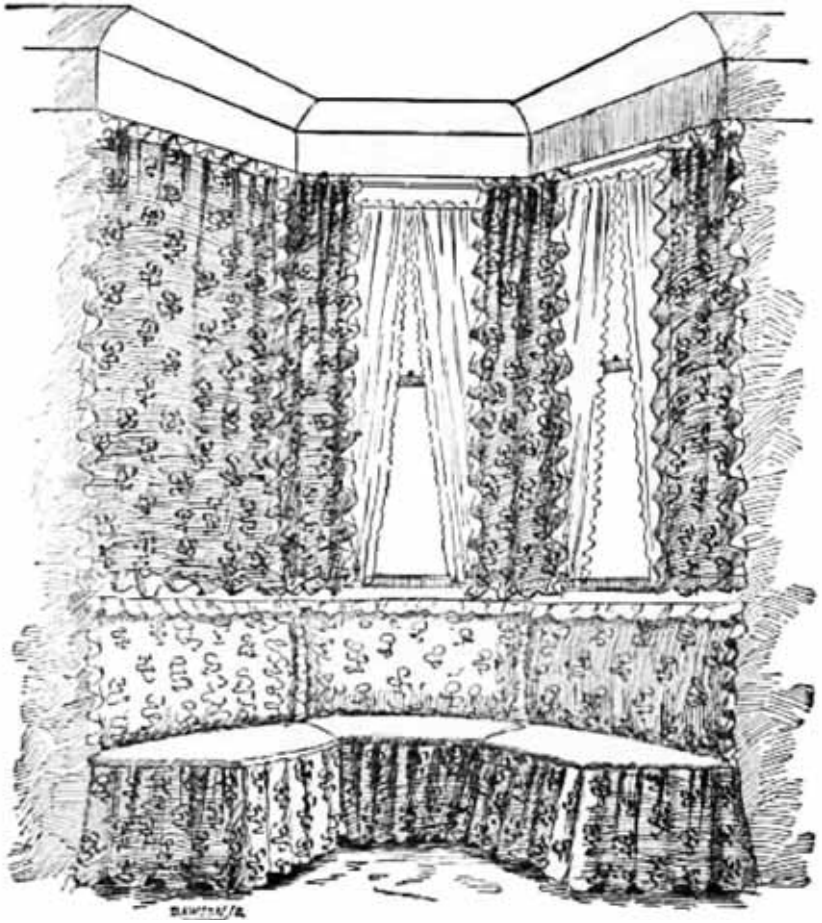
SOURCE: Robyn Pender, Historic England, *Lecture to the Rumford Club* (20 Feb 2020).

2. DRAUGHTS & "COLD" RADIATION:

Victorian soft furnishings were partly for thermal reasons



"This [cord] allows the curtain being dropped in one moment should more warmth be desired."



"[the male architect]… too many windows … and almost ruins us in blinds and curtains"

SOURCE: J E Panton, *From kitchen to garrett: Hints for young householders,* Ward & Downey (7th Edition 1890).

2. DRAUGHTS & RADIATION:

Simple ways of countering losses and gains

Traditional Orkney high-backed chair with drawers for whisky and a Bible.

Ad hoc external shading by old linen sheets during 2022 London heatwave kept peak internal temperatures below 27 C.

3. CLOTHING: Back to the Future *in a chateau*

Modern winter layers – awkward indoors and ultimately not warm enough

An Erasmus-style hat is comfortable and warm

Late medieval Burgundian coats – finally warm enough!

Cone-shaped mediaeval garments proved to be the warmest and most controllable

Heating one 40 m^2 room to 10-15˚ C with a log fire needed less than 5% of the fuel required to heat the whole building to the high teens using modern wood burning stoves.

SOURCE: J Parker, *Returning to old ways of staying warm,* (2016), www.traditioninaction.org/Cultural/C042_Warm.htm

We should be able to run some buildings cooler, *but what about moisture?*

DAMPNESS IS A MAJOR SOURCE OF ILL HEALTH FOR PEOPLE AND BUILDINGS, DIRECTLY AND INDIRECTLY:

- Water penetration, leaks – *maintenance !*
- People – *ventilation must be adequate*
- Kitchens bathrooms etc. – *extract at source*
- Insulation – *can make things worse.*

ALL ENERGY SAVING STRATEGIES MUST INCLUDE EFFECTIVE MOISTURE MANAGEMENT

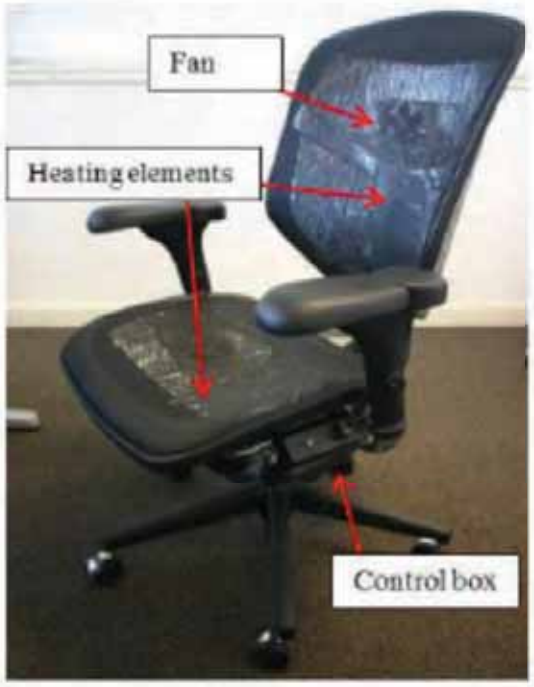
Need for careful survey work and low-cost monitoring.

AND FABRIC-FIRST NEEDS TO START WITH FABRIC MAINTENANCE FIRST

4. LOCAL AND PERSONAL HEATING:
Experiments with 16-zone thermal manikin

Indicative Watts to increase personal comfort by 1° C:

250	Local convector heater
100	Local radiant panel
35	Local foot warming mat
<10	Heated chair or cushion



Max heating power 14 W
Max cooling power 3.6 W

* S Kohn, *Development of a Personal Heater Efficiency Index,* MSc Thesis, University of California, Berkeley (2017).

5. USER-FRIENDLY CONTROLS

"In a Machine for Living, I want to be in the driving seat" – OCCUPIER

"We sell dreams and install nightmares" – CONTROLS MANUFACTURER

THE RUNBACK TIMER:

The most neglected control?

perhaps no longer … ?

PEOPLE ARE THE BEST JUDGES OF WHAT THEY WANT … BUT

YOU CAN NEVER HAVE TOO MUCH OF A GOOD THING

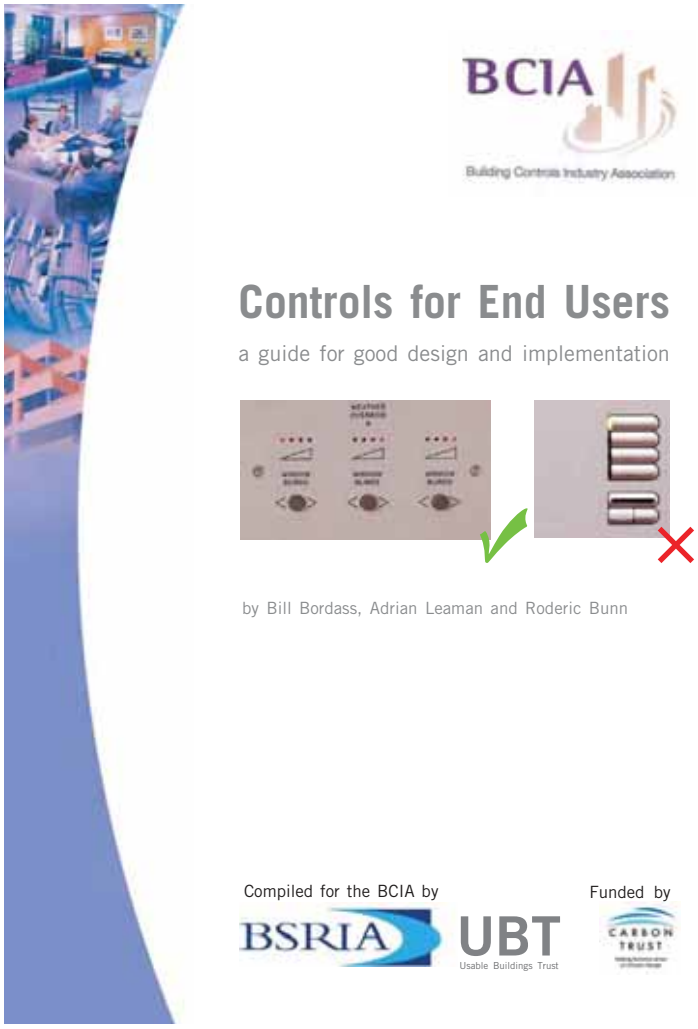
5. USER-FRIENDLY ROOM CONTROLS

A few principles for both passive + active systems

- **Easy to reach**
  from the point of need
- **Easy to use** and understand,
  and preferably intuitively obvious
- **Acknowledge interventions**,
  so you know things are going to happen
- **Default to off**, safe or standby,
  so energy isn't wasted.

PLUS Rapid system response:
Widens thresholds of acceptability, by lessening any anxieties that conditions might continue to deteriorate. Conversely, slow or no response narrows thresholds for a "crisis of discomfort".

BUT People are not good at anticipation:
advice, decision support, or backup (e.g. mixed mode) systems may be needed.



SOURCE: B Bordass, A Leaman & R Bunn, *Controls for end users,* Building Controls Industry Association BCIA (2007)

6. THERMOREGULATORY FITNESS

*Improving one's personal thermal physiology**

- **Habituation** to uniform thermal environments
  has reduced our thermoregulatory capacity to cope with temperatures outside the range of conditions we normally experience.

- **We CAN be more resilient**
  Acclimatisation has been shown to improve the ability to regulate body temperature in young, middle-aged and overweight individuals.

- **This will require "temperature training"**
  More thermal variation in everyday life will improve cardiovascular and metabolic health, save energy, and help us adapt to climate change.

BUT *We will still need to protect ourselves*
(and particularly vulnerable individuals) from the hazardous effects of thermal extremes and other health issues, especially those related to moisture management.

---

* POINTS SUMMARISED FROM: H Pallubinsky *in Physiology and climate change,* The Physiological Society, 19-21 (2021).

7. REFUGES

both local and communal

JAPANESE KOTATSU HEATED TABLE.
Also used in Middle East and WW1 trenches.
Traditionally charcoal. Often electric today.

PUBLIC REFUGE IN PORTLAND, OREGON
During the “heat dome” temperature extreme
in late June 2021.

See also S Roaf, *Cool and Cosy Corners,* www.bdonline.co.uk/opinion/buy-your-gran-a-cosy/cool-corner-for-christmas/5120354.article

RECAP: SOFT RETROFITS
Beyond space heating and cooling

"Evening out fluctuations has become an egalitarian enterprise which it is heresy to question." - MICHAEL YOUNG

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AND

8. Plan to avoid health-related unintended consequences.

MICHAEL YOUNG, *The Metronomic Society: Natural Rhythms and Human Timetables,* Thames & Hudson (1988)

THANK YOU
DISCUSSION

"C'mere, space heater."

'Faster! The lights are dimming'

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