Building Performance Evaluation: Who Benefits?

Adrian Leaman

Usable Buildings Trust | Building Use Studies

Cardiff Metropolitan University, 2 September 2013

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A series of case examples illustrating who benefits from

Building Performance Evaluation

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Building Performance Evaluation is primarily about obtaining believable feedback to help improve design and management.

Three perspectives

Human needs: Are needs being met?
Environmental performance: How benign?
Affordable and manageable?

One objective

Better feedback aimed at the most effective people in the process.

Hardly any modern buildings work well in all three, so all-round improvement is the main justification for BPE.

Beware of vanity studies: those concerned mainly with benchmarking and self-promotion.
Example to follow!

Examples

1. The classic *Probe* study: Elizabeth Fry Building.
2. Design feedback: Irish generic schools programme.
3. Before and After studies: CH1 and CH2, Melbourne.
4. Diagnostics and remedial: St Philips' Place.
5. PhD research: Domestic building user behaviour.
6. Meta-analysis: e.g. Killer variables

There are many more, including, e.g., developers assessing performance of office space provided for rent, school design and performance, support for energy monitoring studies, student project work, as part of *Soft Landings,* as background for strategic and technical development, as part of user and control studies.

1. The classic *Probe* study: Elizabeth Fry Building

Elizabeth Fry Building, University of East Anglia, Norwich, UK

TEST of TIME

Too many new public and commercial buildings fail to live up to their expectations for energy savings and user comfort, but can the good ones maintain their performance? With support from CIBSE, a team of experts returns to a university building that was found to perform exceptionally well in the late 1990s. **Bill Bordass** and **Adrian Leaman** report on their findings. A separate article on the performance of school buildings generally starts on page 39

A 'PROBE' investigation into the Elizabeth Fry Building at the University of East Anglia in the 1990s found that it had exceptionally good performance in many respects. A recent follow-up visit found that, despite some inevitable 'drift' in its operations, it is still performing better than many brand-new buildings. In the background is the Queen's Building, an earlier building by the same design team

In the early 1990s, the editorial advisory board of *Building Services Journal* (the forerunner of *CIBSE Journal*) had wondered how well the buildings it featured actually performed in practice. In 1994 the *Journal* made a successful bid under the government's Partners in Technology programme to undertake and publish the 'PROBE' (Post-occupancy Review Of Buildings and their Engineering) studies.

Between 1995 and 2002, a total of 20 non-domestic buildings were surveyed, typically two to four years after handover. The process, results and general findings are described in 29 articles in the *Journal*, and in reviews elsewhere.

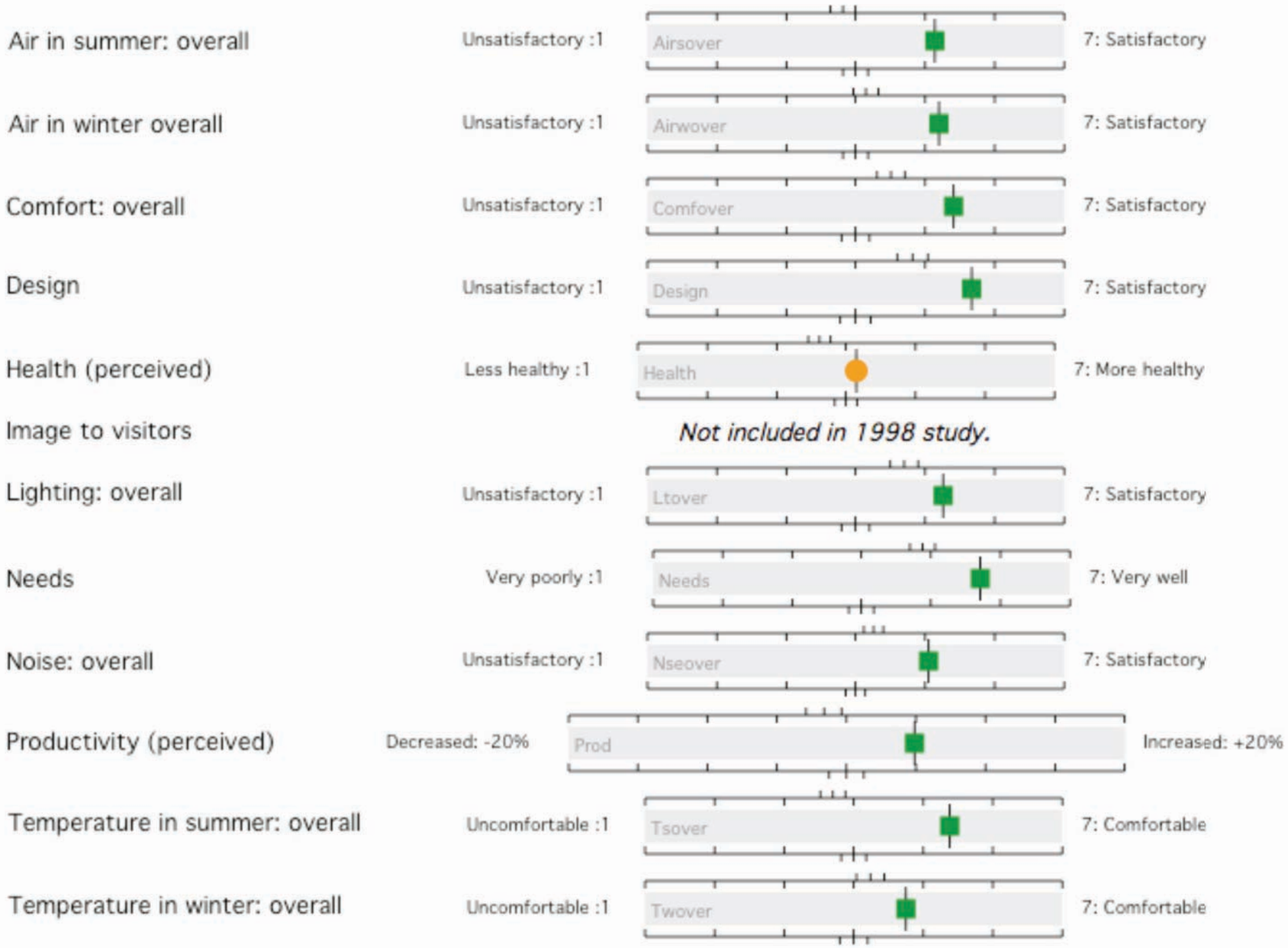
PROBE number 14 investigated the Elizabeth Fry Building at the University of

Test of Time download

Elizabeth Fry building	
Findings in public domain	Yes
Commissioned by …	Initially Probe project funding (50% government, 50% private matched)
Followed up	Yes, ten years later.

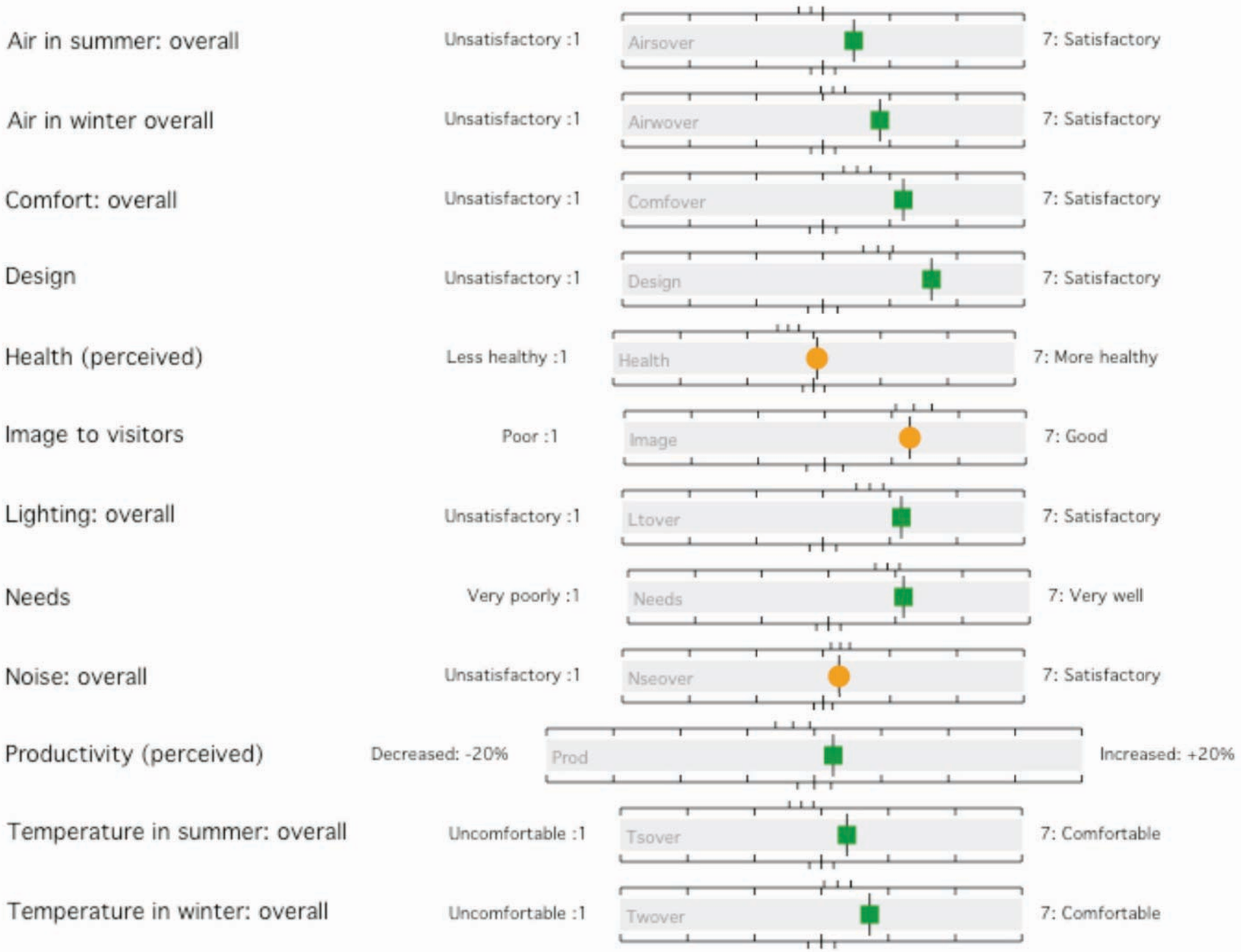
Elizabeth Fry 1997 study

Summary (Overall variables)



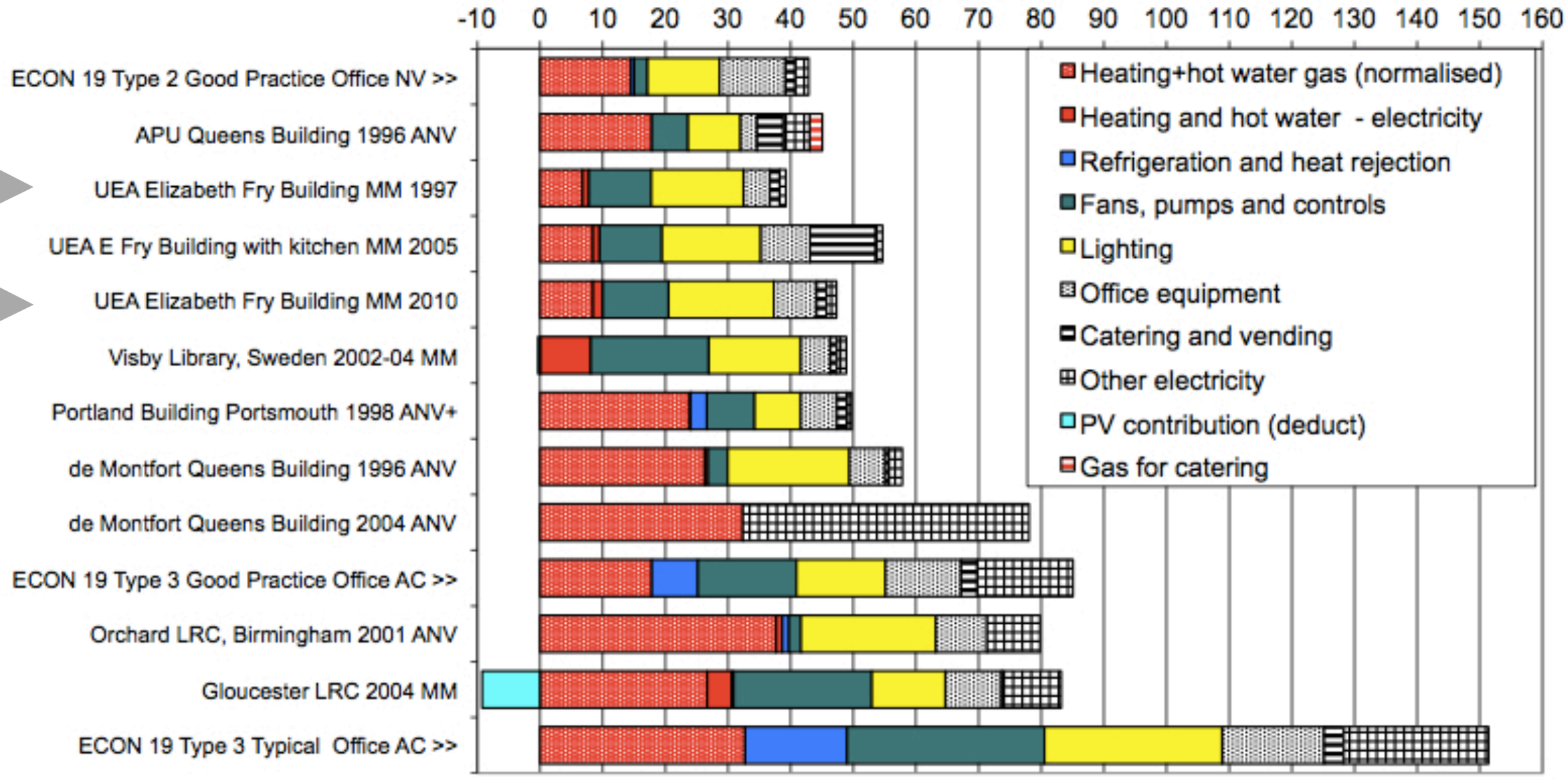
Elizabeth Fry 2010 study

Summary (Overall variables)



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

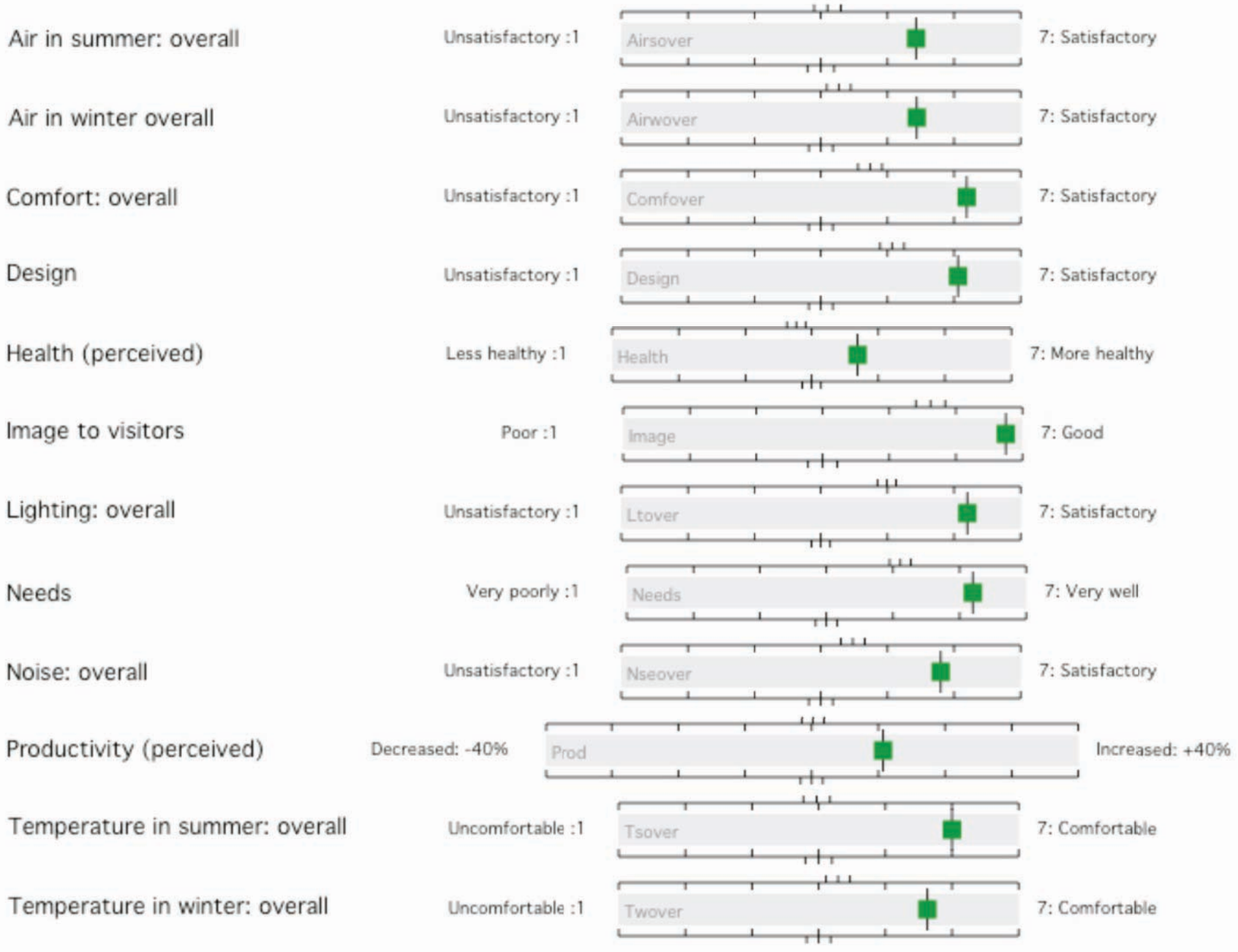


AC= Air Conditioned, ANV = Advanced Natural Ventilation, MM = Mixed Mode.

2. Design feedback: Irish generic schools programme.

Irish Generic Schools programme	
Findings in public domain	Partial.
Commissioned by …	Student project (Noel Guilfoyle, CAT)
Followed up	Ongoing construction but assessment unclear.

Summary (Overall variables)



St John the Apostle

Total 31 kWh/m2

2011-2012 19 kWh/m2 gas 12 kWh/m2 electricity

Occupied 8:50 to 2:30 Mondays to Fridays for 183 days in the year.

Some after hour classes

Community group on Sundays

Heating switched off from April to October,weather permitting

During heating season heating switched on for 2.5 hours a day on a school day and 2 hours on a Sunday.

ISSN 2072-7925
Ireland's generic repeat design schools programme
CELE Exchange 2011/5

Ireland's generic repeat design schools programme

By Tony Sheppard, Department of Education and Science, Ireland

The Irish Department of Education and Skills (DoE) is strongly committed to energy efficiency and to reducing CO_2 by developing and implementing energy level ceilings in relation to school design that aim to remain below half of the accepted good practice in the field. This approach works within normal departmental budgetary limits to create school buildings that are breaking ground for building designers.

INTRODUCTION

Practical simplicity

The DoE's Planning and Building Unit is now developing low-energy educational buildings with the help of generic repeat design (GRD). This is a programme delivering many primary schools, not just a single demonstration prototype building. To minimise risk on so many projects, it brings together proven-in-use technologies. It is significant because of the practical simplicity of its low energy design and repeatability on sites with varied orientations.

South-facing two-storey classroom block and entrance of first-completed GRD school

© David Barbour/BDP

Precedent

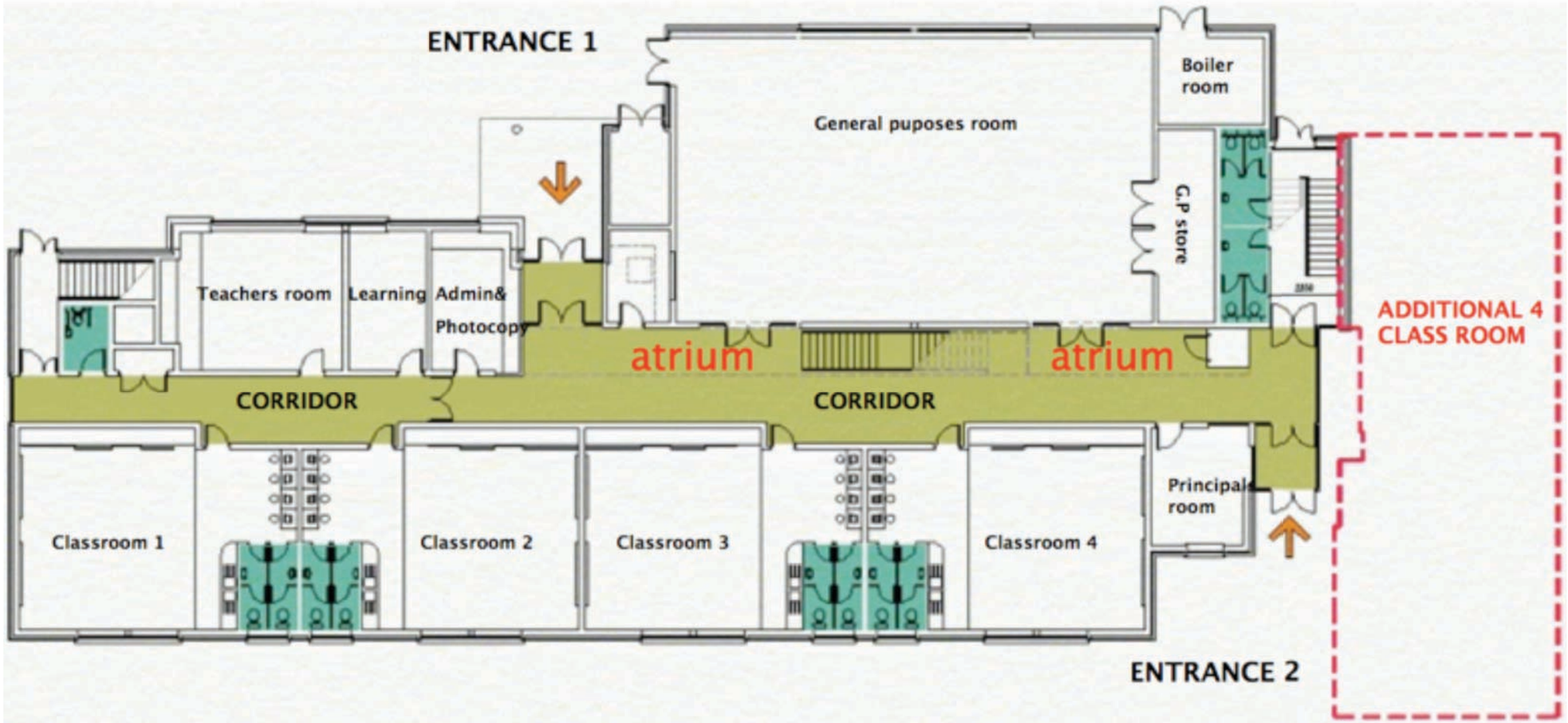
There are clear precedents in Ireland for the use of highly refined standard school plans as part of the government's response to the demands of providing accommodation for large numbers of pupils. The GRD has evolved this procurement method with complete superstructure tender packages available.

Previous research

Given the requirement to minimise risk on multiple projects, the GRD brings together all currently available proven and tested-in-use technologies.

Irish Generic Schools Programme download

Typical questions to designers from building evaluation studies' debrief


ENTRANCE 1
Boiler room
General puposes room
G.P store
Teachers room
Learning
Admin& Photocopy
atrium
atrium
ADDITIONAL 4 CLASS ROOM
CORRIDOR
CORRIDOR
Principal room
Classroom 1
Classroom 2
Classroom 3
Classroom 4
ENTRANCE 2

Q

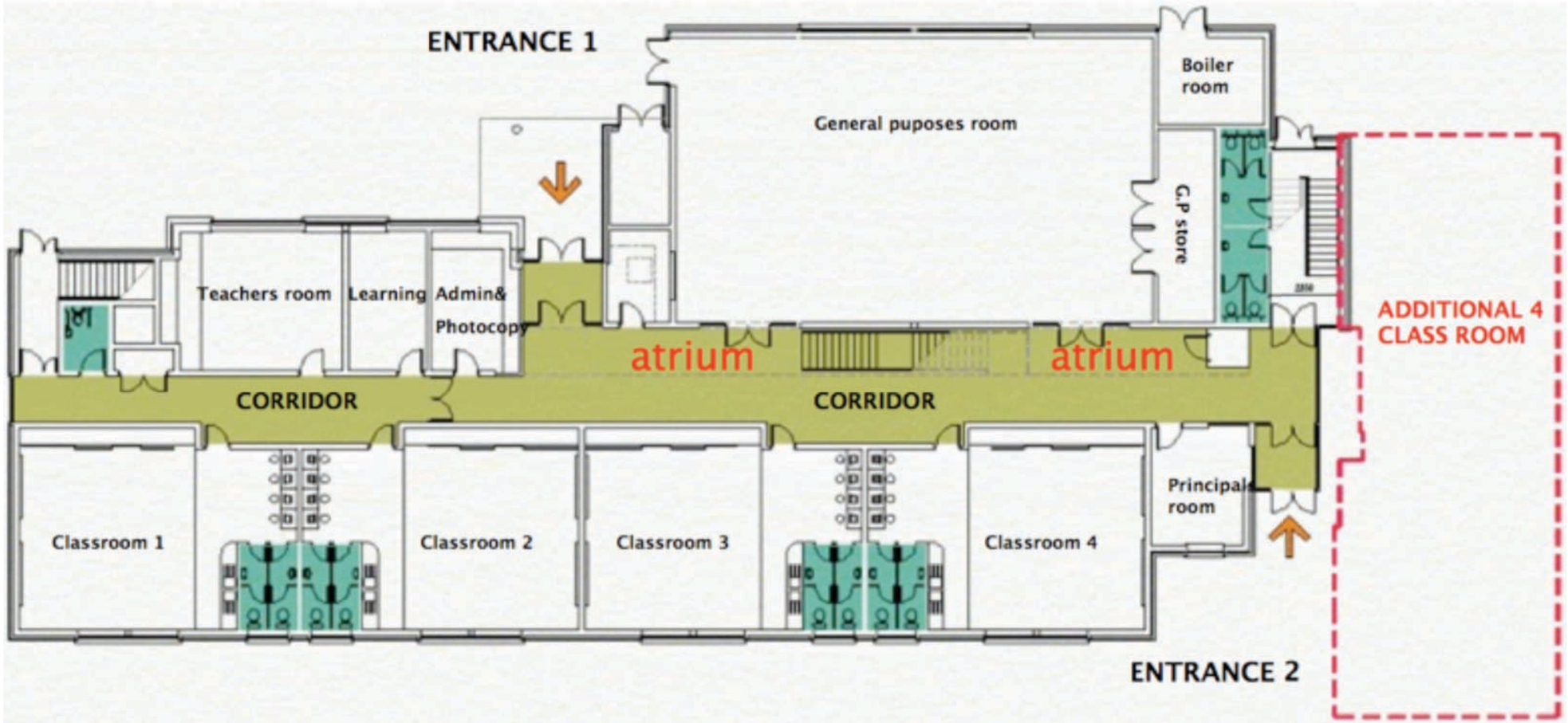
Blinds are down on nearly all the high level windows on the south side, designed to provide deep daylight, and quite a lot of the lower ones too. Why?

A

"... the Metadata on this photo indicated a time of 14.52 in May, so I suspect pupils have left all of the classes for the day. The caretaker or teachers close down blinds to enhance security (and reduce night time radiation loss). The first on left with blinds and windows open is used as a staff room so it may be still in use."

Q

Why two entrances?



"One of the drivers of the dual entrances was the need to locate these schools on multiple sites with various approach orientations."

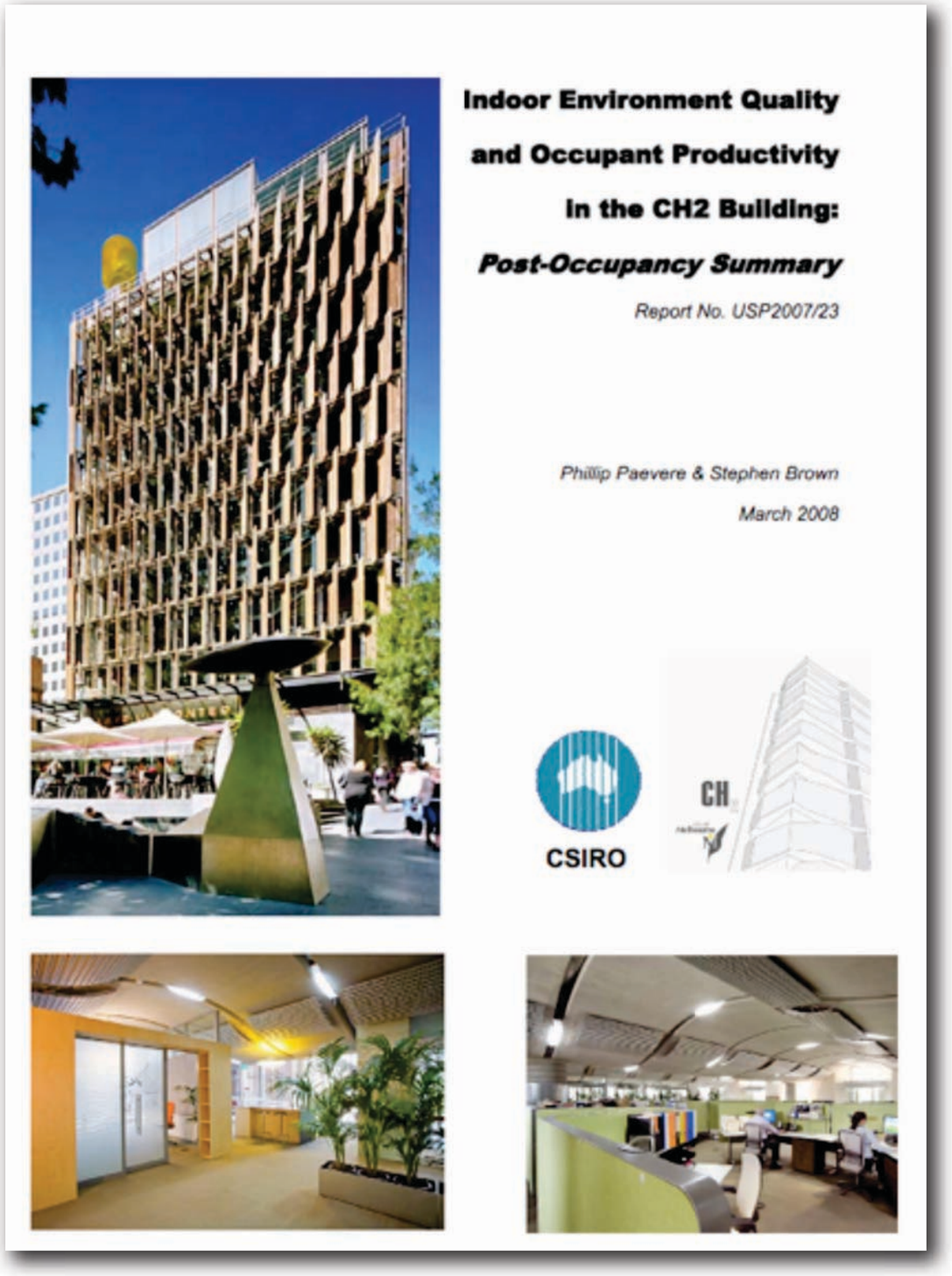
“Note lights on in atrium. At least there aren't very many of them. This is something that [we have seen] on several school visits. Down to failure to calibrate daylight sensors that are covering this area. Like the roof light. But can the atrium be blacked out?

“This roof light worked out well. It has opal glass to disperse any direct sunlight. We have refined this feature further on another school ... under construction. As these hall-type spaces are usually located north-facing .. we normally have not provided glare or blackout blinds.”

3. Before and After studies: CH1 and CH2, Melbourne.

CH2	
Findings in public domain	Some, but energy and water not available
Commissioned by …	City of Melbourne
Followed up	Not known

Download report



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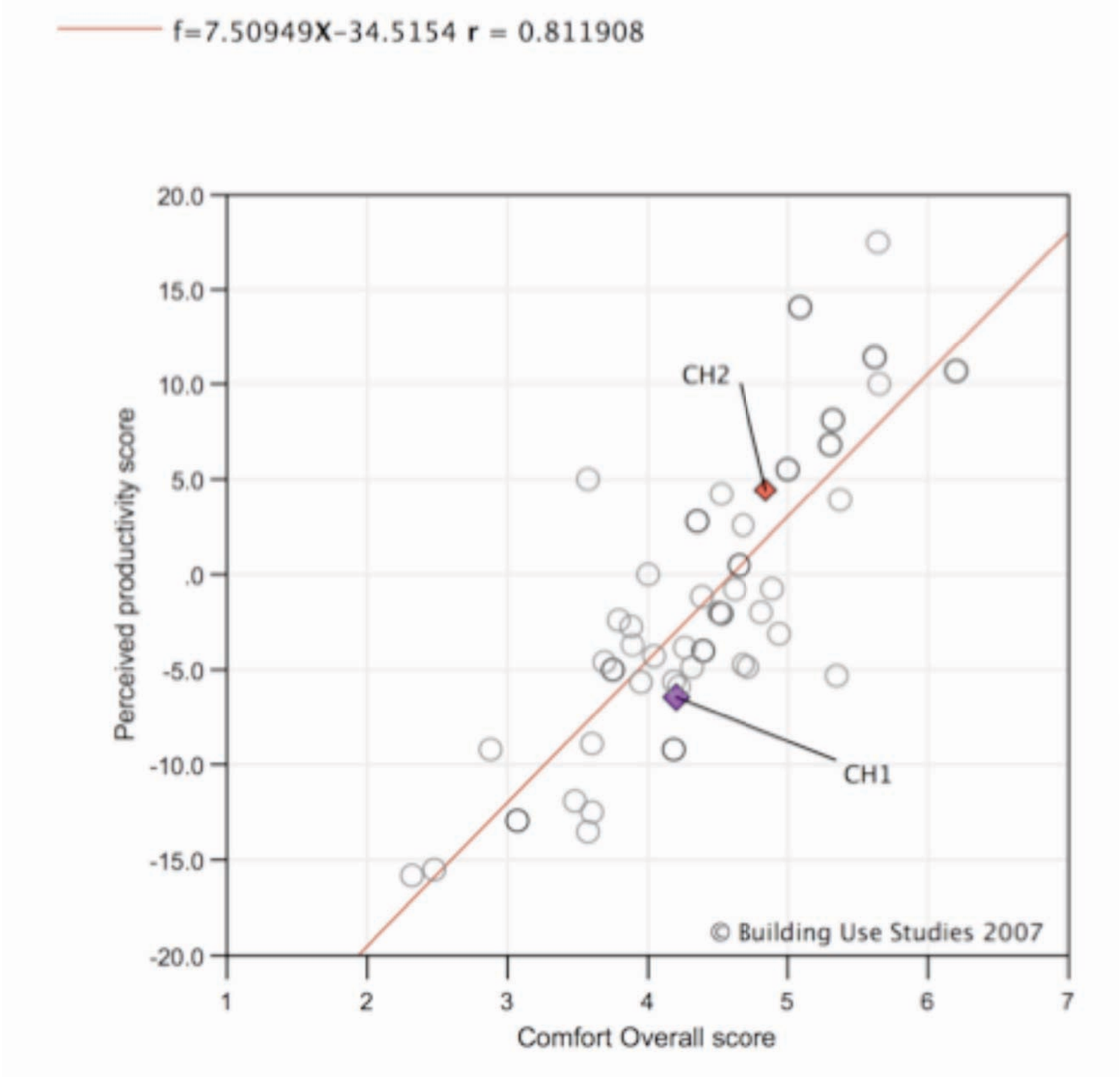

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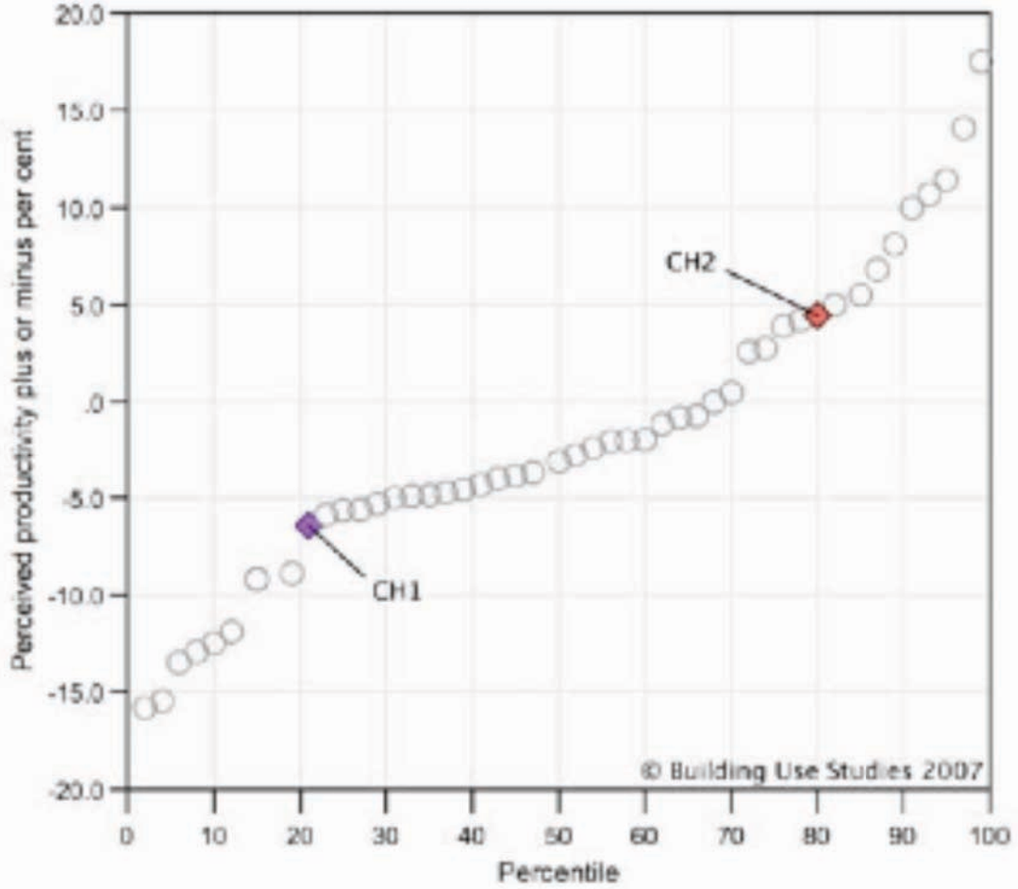


Figure 13: Comparison of perceived productivity loss or gain, for CH1 and CH2 against BUS Australian building dataset

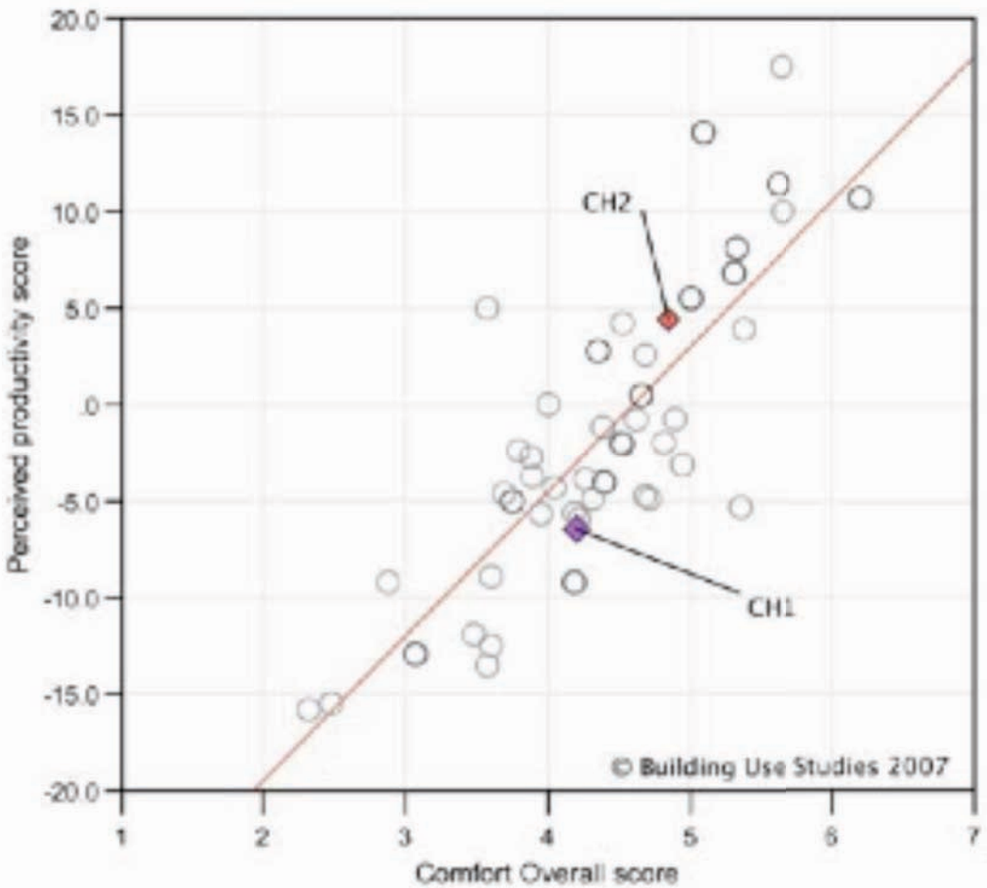


Figure 14: Perceived productivity loss or gain versus Overall Comfort: CH1 and CH2 compared to entire BUS Australian building dataset

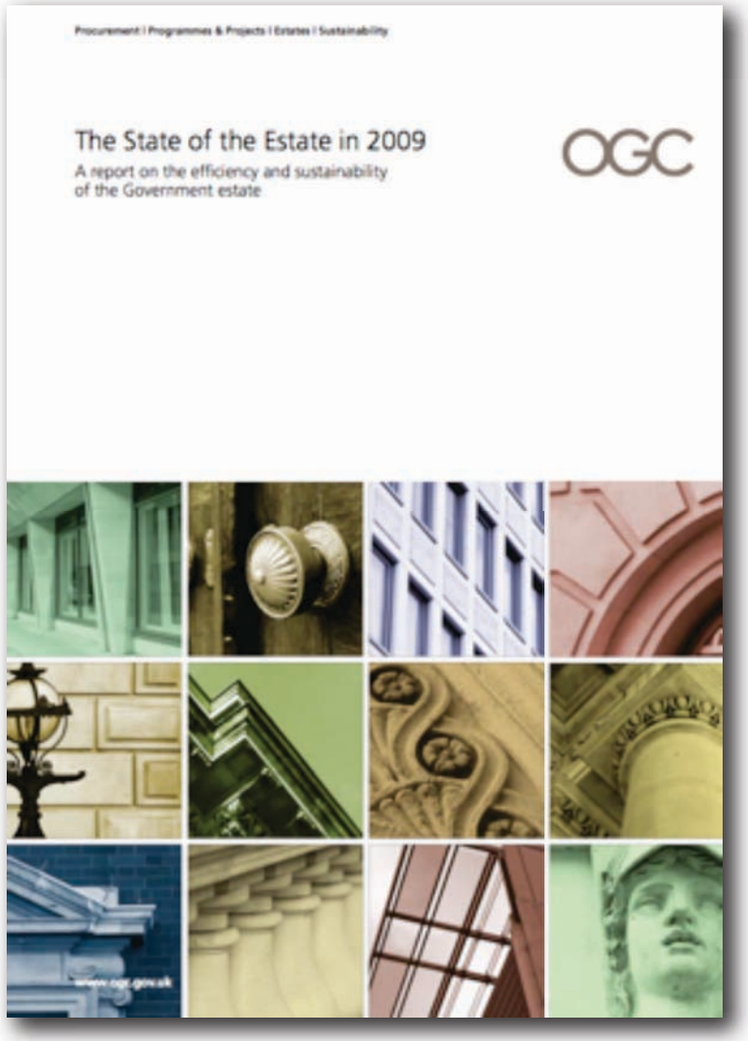
‘There is nothing more dangerous than a heckler with statistics.’

Rich Hall

4. Diagnostics and remedial: St Philips' Place.

St Philips' Place	
Findings in public domain	Limited
Commissioned by …	Office of Government Commerce
Followed up	No

Download report



- Boiler operational improvements including boiler switch off in summer.
- Improved control of occupiers' equipment.
- Improved lighting control in common parts and office areas.
- Supply voltage stabilisation.

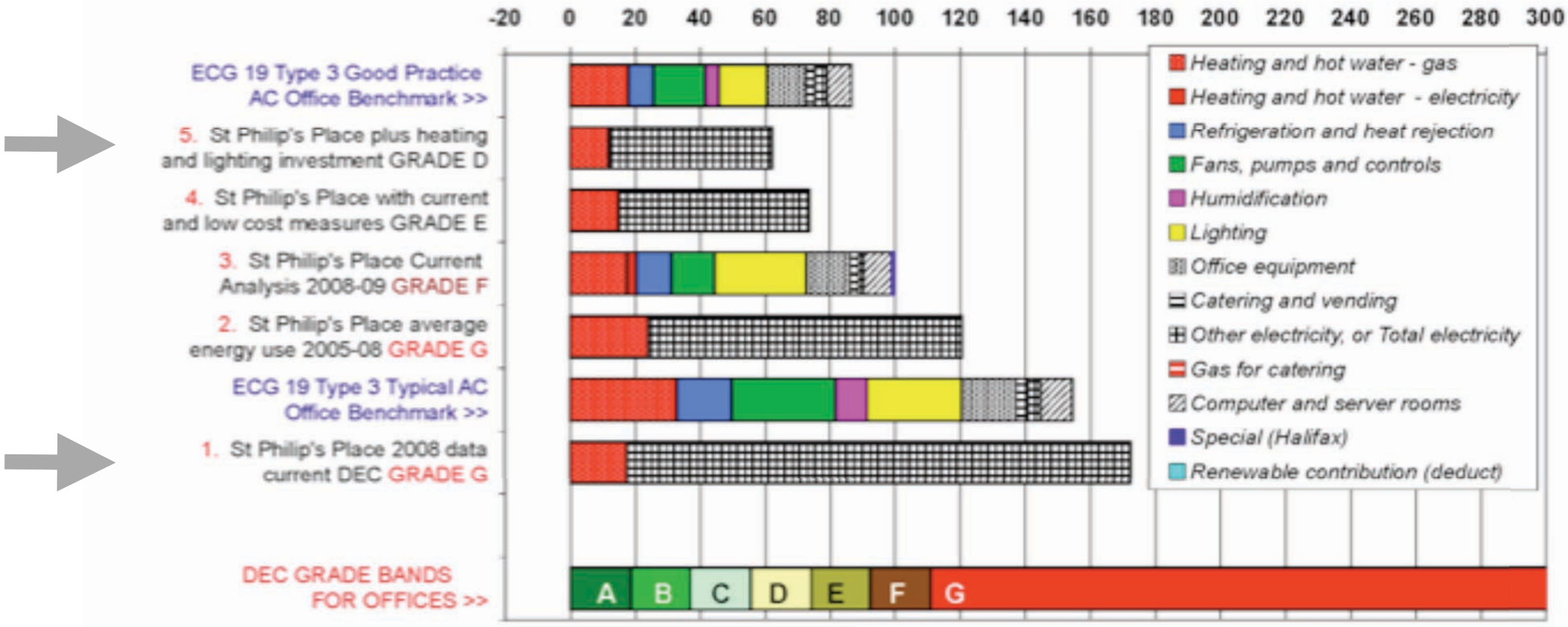
- Resolution of supply metering and sub-metering.
- Improved operation of Building Management System to avoid of system hunting and unwanted circulation in heating and cooling circuits.
- Installation of a lead condensing boiler.

Lack of commissioning of sub-meter check meter led to overspend on electricity of £385,000 over 5 years.

5 ST PHILIP'S PLACE OFFICES:

Annual CO_2 emissions, DEC Grades and benchmarks from Energy Consumption Guide 19 for a "Type 3" air-conditioned office

kg/m² Treated Floor Area at Defra 2008 CO_2 factors of 0.185 for gas and 0.537 for electricity



December 2012

Display Energy Certificate

How efficiently is this building being used?

HM Government

Government Office
Department for Communities and Local Government
5 St. Philips Place
BIRMINGHAM
B3 2PW

Certificate Reference Number:
9790-5933-0152-3090-9030

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

Energy Performance Operational Rating

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

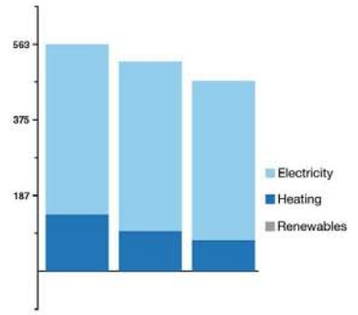
More energy efficient

A 0-25
B 26-50
C 51-75 ◀ 73
D 76-100
100 would be typical
E 101-125
F 126-150
G Over 150

Less energy efficient

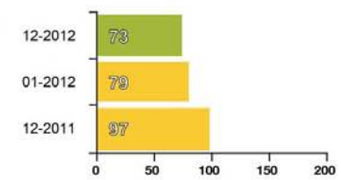
Total CO_2 Emissions

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



Previous Operational Ratings

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



Technical information

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

Main heating fuel: Natural Gas
Building Environment: Air Conditioning
Total useful floor area (m^2): 7651
Asset Rating: Not available.

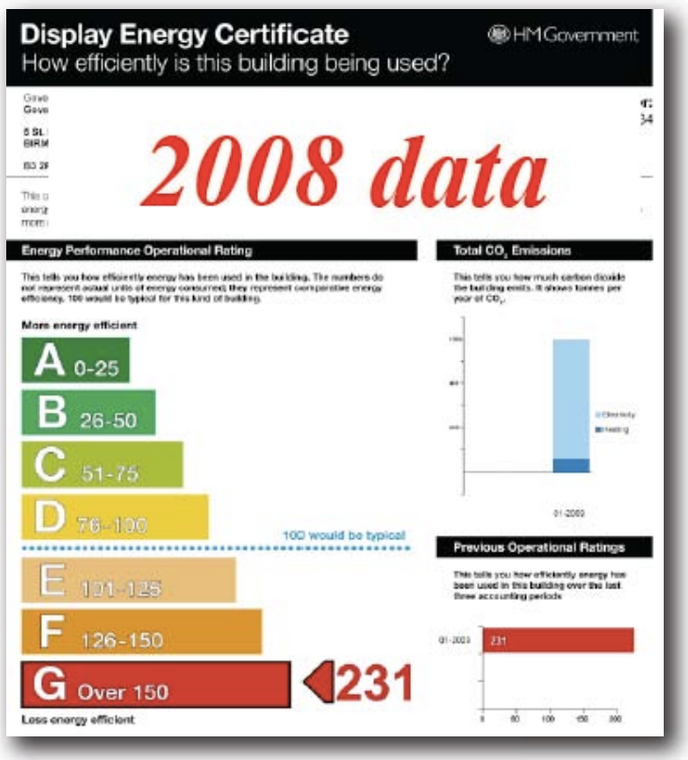
	Heating	Electricity
Annual Energy Use (kWh/m^2/year)	51	94
Typical Energy Use (kWh/m^2/year)	132	108
Energy from renewables	0.0%	0.0%

Administrative information

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

Assessment Software: SystemsLink, ORToolkit, v3.6
Property Reference: 535339930000
Assessor Name: Anthony Daley
Assessor Number: STRO000398
Accreditation Scheme: Stroma Certification Ltd
Employer/Trading Name: Interserve
Employer/Trading Address: 395 George Road Erdington Birmingham B23 7RZ
Issue Date: 30-11-2012
Nominated Date: 29-12-2012
Valid Until: 28-12-2013
Related Party Disclosure: Not related to the occupier

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



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5. PhD research: Domestic building user behaviour.

Zack Gill thesis	
Findings in public domain	Thesis plus research papers
Commissioned by …	University of Bristol
Followed up	Ongoing area of research

The University of Bristol

BUILDING PERFORMANCE EVALUATION OF ASPIRING LOW CARBON AND LOW ENERGY DOMESTIC BUILDINGS AND THE IMPACT OF OCCUPANT BEHAVIOURS

Zachary M. Gill

Industrial Doctorate Centre in Systems

January 2012

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Building Research & Information (2010) 38(5), 491–508

RESEARCH PAPER

Low-energy dwellings: the contribution of behaviours to actual performance

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The UK Government's *Building a Greener Future: Policy Statement* (2007) announced that all new homes must be zero carbon from 2016. To date, a number of housing sites around the UK have strived to reduce carbon emissions by following sustainable design principles and utilizing renewable technologies. On paper, these sites exceed regulatory compliance and are regarded as high-performance buildings. However, their actual performance is seldom validated from the perspective of either the design engineer or the occupants. Findings are presented from an on-going post-occupancy evaluation of a UK EcoHomes site with an 'excellent' rating (the highest rating of the predecessor to the current standard, the Code for Sustainable Homes). The detailed post-occupancy evaluation investigated the energy performance of the buildings (as well as water consumption) and the comfort and satisfaction of users. A bespoke behavioural survey and interview were developed and implemented to distinguish between and quantify frugal and profligate patterns of consumption. Results indicate that energy-efficiency behaviours account for 51%, 37%, and 11% of the variance in heat, electricity, and water consumption, respectively, between dwellings. Human factor issues need to be addressed more adequately as standard practice in low-energy/carbon design.

Keywords: building performance, consumption assessment, housing, low-energy building, occupant behaviour, post-occupancy evaluation, theory of planned behaviour

La déclaration de principe du Gouvernement Britannique intitulée *Building a Greener Future: Policy Statement* (Construire un Avenir Plus Vert: Déclaration de Principe) (2007) annonçait que tous les nouveaux logements devraient être zéro carbone à compter de 2016. A ce jour, un certain nombre d'ensembles d'habitation à travers le Royaume-Uni se sont efforcés de réduire les émissions de carbone en suivant des principes de conception durable et en utilisant des technologies renouvelables. Sur le papier, ces ensembles d'habitation vont au-delà des obligations réglementaires à respecter et sont considérés comme des bâtiments à hautes performances énergétiques. Néanmoins, leurs performances réelles sont rarement confirmées du point de vue de l'ingénieur concepteur ou des occupants. Sont présentés les résultats d'une étude en cours relative à l'évaluation après occupation d'un ensemble d'habitation britannique EcoHomes classé « excellent » (la notation la plus élevée prévue par la norme antérieure à la norme actuelle, Le Code pour des Logements Durables). Cette évaluation détaillée après occupation a examiné les performances énergétiques des bâtiments (aussi bien que la consommation d'eau), ainsi que le confort et la satisfaction des utilisateurs. Il a été élaboré et procédé à une enquête comportementale sur mesure, avec entretien, afin de pouvoir faire la distinction entre les habitudes de consommation économes et dépensières et de les quantifier. Les résultats indiquent que les comportements éco-énergétiques représentent respectivement 51 %, 37 % et 11 % des différences de consommation de chauffage, d'électricité et d'eau entre les logements. Dans une conception basse énergie/bas carbone, il est nécessaire qu'un traitement plus adapté des questions liées aux facteurs humains devienne pratique courante.

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http://www.informaworld.com/journals
DOI: 10.1080/09613218.2010.505371

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Behaviour Survey (Domestic)

This survey consists of a number of statements relating to your use of electricity, heating (and hot water) and water within you home. Please mark (only) one box per statement that corresponds with your response to the statement. Please mark a response for all questions including the General section.

Thank you for participating

General

House Number and Name *(for any follow up issues only)*

House | Name

I consider myself to be environmentally friendly..... 1 2 3 4 5

I consider my behaviour to be energy efficient..... 1 2 3 4 5

I consider my house to be energy efficient..... 1 2 3 4 5

Doing something positive for the environment makes me feel good..... 1 2 3 4 5

Living in an 'efficient' house means that I don't need to think about saving energy and water to be environmentally friendly..... 1 2 3 4 5

Electricity Usage

	Strongly Disagree		Neutral		Strongly Agree
I am aware of how much I spend on electricity consumption.....	1	2	3	4	5
Leaving equipment/lighting on when it is not being used wastes electricity.....	1	2	3	4	5
Reducing electricity usage (and its carbon emissions) at home is an important issue to me.....	1	2	3	4	5
I think I use less electricity than the other houses at (The Site).....	1	2	3	4	5
I think there are people in the UK who use far more electricity than I do.....	1	2	3	4	5
My electrical consumption at home has an impact on the environment.....	1	2	3	4	5
I could save electricity by changing my appliances for more energy efficient appliances.....	1	2	3	4	5
I can influence how the other occupants in the house use electricity.....	1	2	3	4	5
I know what to focus my attention on when it comes to saving electricity.....	1	2	3	4	5
Saving money on my electricity bills is important to me.....	1	2	3	4	5
It is inconvenient to turn things off when I'm not using them.....	1	2	3	4	5
I would feel good if I knew I/we used less electricity than other houses at (The Site).....	1	2	3	4	5
Any electrical reduction effort I make is offset by those who use excessive amounts of electricity.....	1	2	3	4	5
Reducing electricity consumption in the home is only for eco-warriors / hippies / environmentalists..	1	2	3	4	5
I would happily buy more efficient equipment for a slight premium (say ~10%).....	1	2	3	4	5
Everyone in the house needs to work together to save electricity.....	1	2	3	4	5
If I knew where I could reduce my electricity consumption I would make the effort to do so.....	1	2	3	4	5

Heating and Hot Water Usage

	Strongly Disagree		Neutral		Strongly Agree
Reducing my heating and/or hot water consumption saves me money.....	1	2	3	4	5
I can make myself comfortable in the home through other means than heating.....	1	2	3	4	5
Reducing heat and hot water use (and its carbon emissions) at home is an important issue to me.....	1	2	3	4	5
I think I use less energy for heat/hot water than the other houses at (The Site).....	1	2	3	4	5
I feel pressure to reduce heating consumption through the media and government etc.....	1	2	3	4	5
Heating and hot water consumption in the home has an impact on the environment.....	1	2	3	4	5
Making changes to the way I use heating and hot water positively affects my energy performance.....	1	2	3	4	5
I know how to change the thermostat and radiator valve settings throughout the house.....	1	2	3	4	5
Reducing or switching off the heating for periods when the house is unoccupied saves energy.....	1	2	3	4	5
Saving money on my heating bills is important to me.....	1	2	3	4	5
Reducing my heating and/or hot water consumption from its current usage will reduce my comfort	1	2	3	4	5
I would feel good if I knew I/we used less heating and hot water than other houses at (The Site).....	1	2	3	4	5
Advice available to me about reducing heating and hot water consumption is useful.....	1	2	3	4	5
Reducing heating and hot water use in the home is only for eco-warriors / hippies / environmentalists..	1	2	3	4	5
In the future I could easily make changes to reduce my heating/hot water consumption.....	1	2	3	4	5
I have optimised my thermostat and radiator valve settings for the way that I use the house.....	1	2	3	4	5
When the house is unoccupied I ensure that the heating is switched off.....	1	2	3	4	5

Water Usage

	Strongly Disagree		Neutral		Strongly Agree
I am aware of how much I spend on water consumption.....	1	2	3	4	5
Hygiene and cleanliness in the home affects my water consumption.....	1	2	3	4	5
Conserving natural resources of water by saving water at home is an important issue to me.....	1	2	3	4	5
I think I use less water than the other houses at (The Site).....	1	2	3	4	5
I feel pressure to reduce water consumption through the media and government etc.....	1	2	3	4	5
Water consumption in the home has an impact on the environment.....	1	2	3	4	5
I try to keep my personal cleaning time to a sensible level i.e. taking showers, not baths.....	1	2	3	4	5
The (water) fixtures, fittings and appliances in this house are efficient.....	1	2	3	4	5
Having house plants and/or a garden requires a higher water consumption.....	1	2	3	4	5
Saving money on my water consumption is important to me.....	1	2	3	4	5
Hygiene and cleanliness are of the utmost importance to me.....	1	2	3	4	5
I would feel good if I/we used less water than other houses at (The Site).....	1	2	3	4	5
Advice available to me about reducing water consumption in the home is useful.....	1	2	3	4	5
Reducing water use in the home is only for eco-warriors / hippies / environmentalists.....	1	2	3	4	5
Short showers are better for the environment than taking baths.....	1	2	3	4	5
I could use less water from taps, showers and appliances (dishwasher etc) if I thought about it.....	1	2	3	4	5
I like to ensure my plants/garden are regularly watered.....	1	2	3	4	5

Figure A1 Appendix: Behaviour Survey (Domestic). Quantification of occupant behaviour survey (as supplied to residents). *Note*: Implementation or adaptation of this survey without prior agreement from the author is not permitted.

Behaviour survey results

Survey results were returned from 18 occupants in 15 of the dwellings, a sample size of 60%. Where multiple surveys were completed from a single dwelling, the average behaviour score was used for analysis.

Results show that TPB accounts for 51% of the variance in heat demand ($R^2 = 0.51$), 37% of the variance in electricity demand ($R^2 = 0.37$), and 11% of the variance in water consumption ($R^2 = 0.11$) (Figure 10). Therefore, variation in energy-efficient behaviours is concluded to affect both heating and electrical consumption significantly, whereas water consumption is only partially affected. This result is intuitive. For instance, when asked what measures were taken to reduce water consumption, the two most common responses were taking showers rather than baths and turning the tap off when brushing your teeth. Also mentioned was sharing baths, doing full washing loads, and not using tap water for the garden and using RWH instead (although this is mains water when there is insufficient rainwater). Some of these measures do not necessarily lead to lower-than-average water consumption, for instance, a long shower may use more water than a bath and it is unlikely that the length of a shower would be well understood (on a personal and comparative level). Beyond simple indicators of water efficiency, water consumption is more habitual and out of necessity, hence the poor correlation. Heating and electrical consumption can be positively affected by users reducing consumption during occupied and unoccupied periods and by thinking about where waste is occurring, *i.e.* heating on with the windows open and lights/appliances on in unoccupied rooms.

TPB: Theory of Planned Behaviour

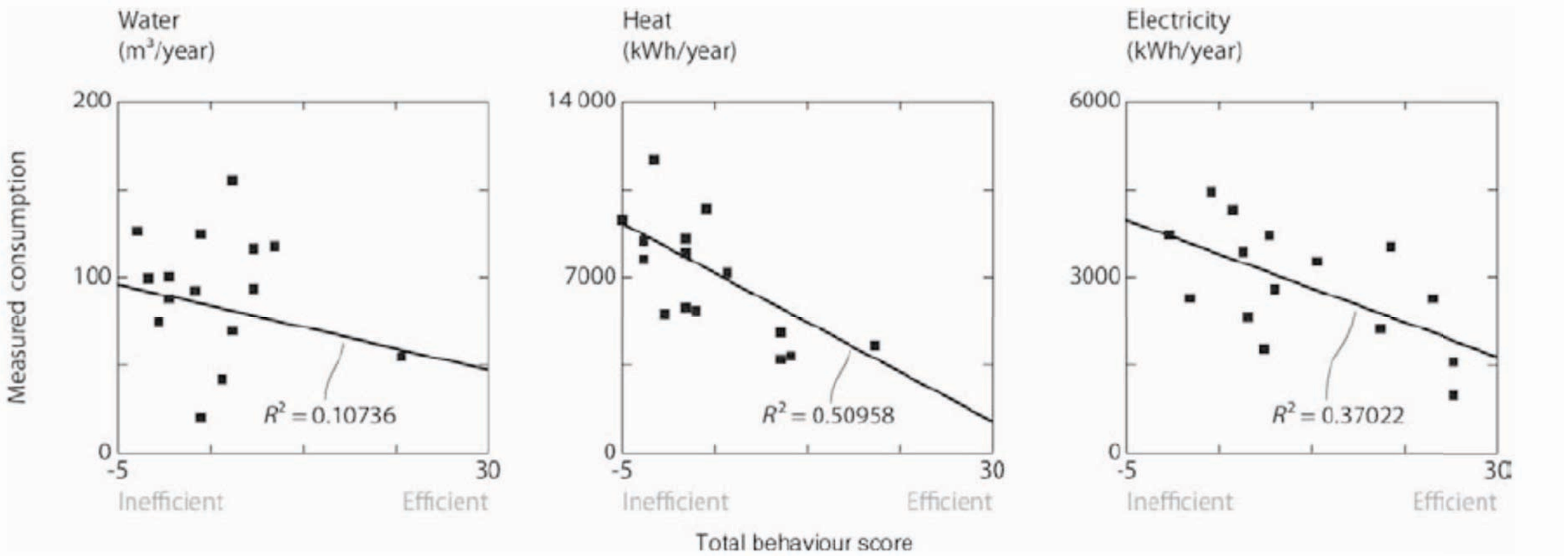

Figure 10 Correlations between behavioural survey results and measured consumption for all resources (heat, electricity and water)

6. Meta-analysis

Meta-analysis	e.g Usable Buildings Trust
Findings in public domain	Free access to material on strategy, lessons learned, methods, etc.
Commissioned by …	Charitable activity in public interest.
Followed up	Ongoing but threatened by lack of strings-free funding

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The Usable Buildings Trust is a UK educational charity, dedicated to improving the performance of buildings in use. We try to understand how buildings actually work in practice, and create a feedback loop from in-use performance to improved delivery by the organisations that can make a difference. We were set up in 2002, because buildings policy and research was becoming too focused on construction, and doing little on performance in operation in the hands of their users. UBT spreads findings through its website, user groups, collaborative working and input to postgraduate courses. UBT is also a home for approaches which are not quite ready for widespread application and an incubator for their development. Aims Background

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Productivity in Buildings: the Killer Variables

Adrian Leaman [1] and Bill Bordass [2]

[1] Building Use Studies Ltd [2] William Bordass Associates
[1,2] The Usable Buildings Trust

Versions have also appeared in Workplace Comfort Forum, London, 1997, October 29-30; Building Services Journal, 41-43 (June 1998); Facilities Management World, 1998, September-October; Building Research and Information, 1999, Jan; chapter of Clemence-Croome D. (ed.) "Creating the Productive Workplace", E&FN Spon, London, 2000 (first edition), 2005 (second edition); Ecolibrium (5-parts, April-September 2005)

Introduction

This deals with the somewhat vexing question of human productivity in the workplace. Vexing because we do not think that this subject is as mysterious as many do. We set out to answer: "What features of workplaces under the control of designers and managers significantly influence human productivity?". The main theme is how individual occupants are affected. We are seeking building features which most readily improve or hinder human productivity at work. The findings can then be used in the briefmaking, design and management processes. We deliberately stick to factors which are in the direct control of building designers and facility managers; not to wider aspects like stress, lifestyle and organisational culture.

Our observations are mainly based on surveys carried out since 1985 in the UK by Building Use Studies and William Bordass Associates (hence the bias in the references). They also incorporate findings from the Probe series of building evaluation studies [Reference 1] with which we were closely involved. There is also a substantial wider literature, as reviewed by Lorsch and Abdou [References 2-4] and Oseland [Reference 5]. Most of these sources can be relied on, but there is also quite a lot written about productivity in buildings which has shaky foundations, so do not take everything at face value, especially exaggerated claims made about productivity gains.

Much is already known about how well people respond to different conditions of temperature, humidity, lighting, ventilation and noise, for example, and regulations for building design are based on many of such findings (although sometimes with a considerable time lag so that when legislation is introduced it can be out-of-date [Reference 6]). Many of these studies come from military, industrial and commercial sources. Although there is a reasonable consensus on key points, their findings can be contradictory and sometimes they can be hard to fathom. For instance, Reference 7 found that young people worked best (and were thus more productive) for short periods when they were uncomfortably cold. Periods of relatively uncomfortable arousal can thus be important. But it is unlikely that people will continue to perform well in conditions of prolonged discomfort, which begs the question of 'how long?'. Reference 8 shows that large numbers of office staff considered their working environments to be thermally unacceptable despite measured conditions falling within industry-standard comfort envelopes, so perceived and measured conditions can be different. Reference 8 also demonstrated that 23.5°C is the temperature which people in offices prefer, but even with this there is a sizable minority of about 35 per cent who wanted it to be warmer or cooler, so minority needs cannot be ignored, although they often are.

Measuring and reporting on human productivity in workplaces is fraught with difficulty. For instance:

- Studies of individual occupants often miss out the wider context of physical and locational differences between buildings, and how they are managed and operated. For example, studies may examine the relationship between lighting and perceived productivity at work, but miss out completely other aspects of the buildings' performance, such as thermal conditions or noise, which not only may be more important factors but may also affect perceptions of lighting as well!
- Buildings and their occupying organisations are rarely even similar to each other from case to case, which complicates comparisons.
- Methodological and interpretational anomalies resulting from the first two points lead to problems with e.g. sampling and sample sizes, assumptions used in studies and spurious detail in the data collected so it can be difficult to filter out the most important points from case to case.
- It is also tempting to use weighting systems to try to iron out differences. For example, the length of time that people spend in a building tends to be inversely associated with their perceptions of comfort, health and productivity, so buildings with more part-time staff may show better scores. But weighting systems are hard to manage properly, and can be difficult to understand, so it usually

Above all, beware …

Unmanageable complexity

Subtext: Is it affordable in the long term?

So …

Keep it simple,

Subtext: More effort required based on feedback from earlier cases.

Do it well.

Subtext: A Soft Landings approach.

With attention to detail in realistic contexts.

Subtext: Is it relevant? Is it risky?