

# NEGOTIATING NEEDS AND EXPECTATIONS IN COMMERCIAL BUILDINGS SUMMARY OF KEY FINDINGS & CONCLUSIONS

## OUTLINE OF THE RESEARCH

This research explored the energy implications of the design and specification of ten new and refurbished office development projects in London. The aim was to develop insights into how escalating expectations of assumed user needs, and their associated standards are designed into the fabric and services of buildings, affecting energy demand, e.g. through choices about cooling systems.

The ten projects studied all date from 2010 and comprise 6 new build developments and 4 major refurbishments. Three of the refurbishments were originally built in the 1980s; the fourth was built in the 1960s and refurbished previously in the 1980s. All of the projects were developed for the letting market although one was taken by a local authority occupier. The buildings varied by size (3,000-23,000m<sup>2</sup>), location within London, development mode and HVAC installation – further details are provided in Table 1 at the end of this document.

To understand how decisions affecting energy performance were made, interviews were conducted with the project architect and Mechanical & Electrical (M&E) engineering consultant for each project. In most cases interviews were also held with letting agents, developers, and/or occupiers as detailed in Table 1. More generally, interviews were also completed with a number of other M&E and building design specialists, leading sustainable office architects, property developers and managers, letting agencies, and those from the key institutions involved in developing office design standards and guidelines. In this report we provide anonymous quotations from those we talked to which illustrate our key findings.

## KEY FINDINGS

Analysis of data revealed important mechanisms affecting energy demand. In summary we found that

- Non-mandatory but hard to ignore industry norms (e.g., Grade A features and the BCO Guidelines) act as ‘market standards’ and have a crucial role in shaping the design, look and feel of contemporary office buildings.
- These ‘standards’ are used to maximise the ‘flexibility’ of buildings to encompass the most demanding potential occupants in the letting market. They lock together and lock in expectations of ever upwardly ratcheting service, resulting in over-specification and provision which affects levels of energy demand.
- If ‘market standards’ were not followed, lower energy demand could be ‘designed in’, reflecting realistic rather than worst case peak loads. Additionally, such designs can be more attractive and productive than their market standard, ‘plain vanilla’ equivalents.
- The potential for designing and developing lower energy offices is dependent on rethinking outdated assumptions about normal office work and tenant needs.

We discuss these findings below, and identify how market standards result in levels of energy demand that are higher than might otherwise be the case. The fourth section explores potential future trends in relation to office buildings, and how these might be responded to in ways that reduce energy demand.

## MARKET STANDARDS

*"a building which has a large, grand, impressive reception area downstairs, commissionaires, lifts up to the floors. On the floor ... raised floors and metal tile suspended ceiling, LED lighting, four pipe fan coil air conditioning ... serviced in the basement by lockers, showers etc. ... clear open plan floorplates with as few columns as possible. I think that's a standard Grade A, brand new office building I think today in the market."* (Letting agent)

In the generally prime location, central London cases we looked at, 'Grade A' provision was prioritised, which meant:

- Maximising development density, including Net Internal Area (NIA) – the lettable floor-space not consumed by risers, stairs, columns and lifts etc;
- Adhering to well recognised specifications of high (enough) quality provision, often specified in technical terms (such as per square metre provision levels), as a way of ensuring any potential tenant's needs can be met;
- Meeting quality norms about the aesthetics of the building to create a marketable product

**Maximising development density and NIA** typically drives office design towards utilising the full site area via deep and open floor-plates arranged around a central services core in as high a building as permissible under planning regimes. This often leads to the use of tried-and-tested building services systems, such as four pipe fan coil unit air-conditioning, which are a known quantity in terms of space requirements (they are viewed as efficient) and provide flexible arrangements for cooling. In contrast, lower energy mixed mode HVAC options require more riser (horizontal) or floor-to-ceiling (vertical) space: both aspects conflict with maximising NIA.

*"a displacement system [demands quite large risers] ... the risers can be a lot smaller with a fan coil unit system ... you want to maximise the net lettable area ... making the core as efficient as you possible can. And that applies to every building."* (M&E consultant)

The imperative to maximise NIA mean that the designing-in of features such as high floor-to-ceiling heights which may allow buildings to be more adaptable to improved energy performing alternatives (such as displacement ventilation) in the future is often considered unacceptable. Developers are typically not convinced that the benefits of improved energy efficiency – which do not always come to them – are worth the potential sacrifice in NIA. Box 1 provides two examples of how interviewees described the kind of alternative, 'non-standard' approaches required to design-in lower energy demand. Indeed, some felt that tenants might prefer them, pointing to examples such as Derwent London's White Collar Factory model, and that in taking more traditional, conservative approaches opportunities are being missed, both to reduce energy demand and make a building more attractive to tenants:

*"there are good examples of some city occupiers who've taken some quite radical alternative space. And I think that's a trend we will probably continue to see"* (Letting agent, major developer)

*"Derwent are very forward thinking, their buildings are amazing ... so they are changing the way things are done ... if an occupier is faced with a choice of two or three buildings and one of those buildings out of the three has the best sustainability rating then it's a compelling case ... from an agents' point of view, that's how it's sold to the occupier."* (West End Office Agents Society)

### Box 1: 'non-standard' approaches that allow the designing-in of lower energy demand

Small sacrifices in terms of NIA can allow higher ceilings and in turn greater adaptability in terms of HVAC strategies. This requires, however, deviation from the standard approach of maximising numbers of floors by minimising floor to ceiling heights.

*"thought had been put into the ceiling heights so that different ... air conditioning strategies could work. In the end the building was locked down and turned back into a four pipe fan coil ... so the flexibility is ... still there but it wasn't used at the time. It was a bit before its time"* (Developer)

*"a normal London developer would try to cram in as many floors in the given height. What we've done is, you could say, sacrificed floor area for volume"* (Derwent London)

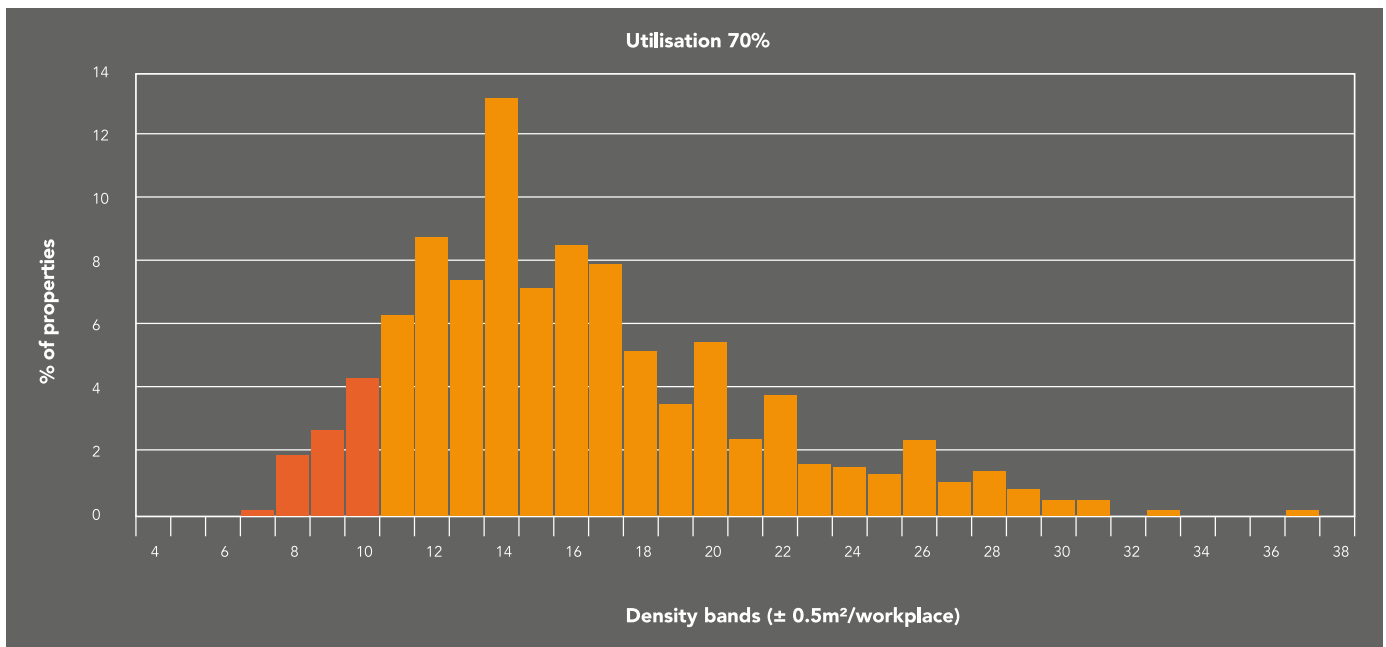
**Common specifications of high (enough) quality provision** relate to technical and performance specifications, i.e. meeting or increasingly exceeding (adding 10% being a common tactic) British Council for Office (BCO) Guidelines. Any building falling below the expected level is deemed sub-standard:

*"You wouldn't design a building to less than BCO standards ... You wouldn't be able to, it's a huge cross if your building doesn't meet BCO standards."* (M&E Building J)

As the BCO acknowledge (see BCO 2013, 2014<sup>1</sup>, and figure 1), strict adherence to (particularly the upper limits of) their guidelines may lead to over-specification in many cases, with provision beyond what the majority of occupiers need in terms of small power, cooling etc. In our case studies over-provision could manifest in negative and energy-demanding ways:

*"[it] was designed for an occupancy of, the whole building was 1:10 but the fifth floor ... in the summer time they were heating the space because the air was too cold coming in."* (M&E Building B)

<sup>1</sup> BCO (2013) *Occupier Density Study*. The British Council for Offices, London; BCO (2014) *Desk Power Load Monitoring JUNE 2014*. The British Council for Offices, London.



**Figure 1**  
Survey of effective densities by BCO, indicating that the majority of offices are occupied well below the design guidance outlined in 2014 BCO Guidance to Specification. Source: BCO (2013: 23)

Underlying such over-specification risks is the ratcheting-up of 'minimum acceptable' levels of specification. For example, air-flow ventilation standards in BCO guidance rose from 8-12l/s/person in 1994 to 12-16l/s/person in 2009. In addition, advice and guidance on a 'gold standard' specification is often used as baseline of provision or as a due diligence check (see box 2).

Ultimately this is a manifestation of how the competitive letting market adopts a logic of 'more is better' in provision. Thus not only ratcheting standards, but the way they are used as a baseline continually increases levels of provision as part of an 'iPhone mentality' (Developer) in which installing the state of the art becomes standard.

### Box 2: over-specification as standard

BCO Guidelines were intended to put a ceiling on specification, but instead many letting agents demand the upper levels of BCO ranges, or even BCO+ (e.g. often adding 10%). For example:

- Ventilation of 12-16l/s/person with 16l/s as the norm;
- Small power provision guidance of 25W/m<sup>2</sup>, being typically exceeded in our case buildings, which mostly provide capacity for 25-65W/m<sup>2</sup>;
- BCO guidance for design occupational density of 1:10m<sup>2</sup> is not matched in use. The BCO Occupancy Density Study 2013 identified that only 4% of the buildings surveyed are likely occupied more densely than the 10m<sup>2</sup>/person recommendations to which buildings are designed. The remaining 96% are therefore over-provisioned.

### Market norms about the aesthetics of the building

result in a focus on delivering bright, airy, open spaces, i.e. a 'blank canvas' which is flexible for any use, for example with few internal pillars and floor to ceiling glazing with expansive views out:

*"there is an explicit request from agents, they like buildings with floor to ceiling glass which let better, you'll get higher rent for them, you'll get prestige"* (Developer)

Such features are seen as the hallmarks of the 'Grade A office' with ever increasing specification of 'lobbies (double height), lifts (fast) and loos (high-spec)' also part of the expected package:

*"what you'll need is BCO spec, BREEAM excellence, other than that it's up to you, marble, need marble these days. And most office agents will say it's ... three things that need to be really good: it's the lifts, lobbies and loos."* (Buildings manager)

Market norms centre in particular on a 'visitor's experience' of the building. Hence another feature is the desire to retain suspended ceilings, given their ability to hide perceived unsightly lighting, ventilation and other systems:

*"there's certain cooling solutions that you wouldn't want exposed. You'd want to hide them. So certain cooling solutions do tend to favour a suspended ceiling type building."* (M&E building J)

In terms of energy, these market norms matter because they result in the designing-in of sub-optimal energy performance: e.g. greater solar gain (from large expanses of glass), or more energy consuming equipment such as multiple fast lifts or bright lights. They can also rule out lower energy approaches to managing the indoor environment, such as mixed mode ventilation that exploits thermal mass and may require the removal of suspended ceilings.

*“full height glass ... in terms of pure technical ... that ought to go, but ... when a tenant’s walking around it’s far more attractive ... the aesthetics and ... potential letting issues ... override energy issues.” (M&E building E)*

**Conclusion 1: adherence to market standards results in the designing-in of over-specification with implications for energy demand**

Together, the need to maximise development density and NIA, common specifications, often of BCO+, and market norms about aesthetics produce what we call market standards: not regulations, but powerful expectations about what should be designed-into a commercial office. Interviewees unequivocally agreed that deviating from these market standards was difficult and risky, particularly with funders, developers and letting agents perceiving them to be non-negotiable and essential features of a lettable building. Market standards have thus become a form of tradeable currency.

Underlying the importance of market standards is the fact that the ultimate occupiers of an office are unknown at the design stage of speculative development – one important role of standards is to substitute for bespoke design. It is easy to understand the temptation to ‘ratchet up’ these standards, especially when the costs of doing so – such as in the case of small power provision – may not be so great compared to the potential benefit of securing an as yet unknown future tenant. However, such market standards substitute for knowledge of actual occupier needs and requirements, and as we have shown tend to be used in a way that leads to mass over-specification. More than that, their associated ‘default’, taken-for-granted systems (such as the four pipe fan coil air conditioning system) are intrinsic to the generation of higher energy demand than might otherwise arise from a more considered appraisal of potential office use.

**FLEXIBILITY**

As hinted above, flexibility is a key concept affecting the processes of office building design. It applies to:

**Buildings and the rental market:** The speculatively developed office building needs to have a form, fabric, structure and, in particular, environmental services that are flexible to occupation by more or less anyone, including tenants with the highest occupational densities and/or small power requirements. The flexible building is therefore seen as one that is over-specified and conforms to the market standards outlined above:

*“the space isn’t going to suit everybody 100%. But it’s amazing what they can do with the space planning ... the more generic boxy buildings ... you can make them work” (Buildings manager)*

Cutting across this issue are developments in the rental market. The steady decrease in the length of leases<sup>2</sup> and ‘break’ periods increase the demand for flexibility. A building is now more likely to be occupied by more tenants for shorter periods of time, meaning designs are expected to be able to cater for a wider range of occupier types:

*“there’s always going to be tenants that come in and out ... clients that are on the move for whatever reason, some clients ... only sign up for five years and then move ... you know the layout isn’t going to ever suit everyone perfectly but it’s going to be close enough” (Buildings manager)*

**Working practices and space budgets:** Changes in work and the use of space are continuous. Recent years have seen transitions from cellular offices, to open plan, to hot desking and the introduction of more and more forms of break-out space and space for collaborative working. Changes in technologies and ideas about productive space and work practices underlie such dynamics. The way in which informal working first seen in the TMT (Technology, Media & Telecom) sector has spread more widely exemplifies this<sup>3</sup>.

Taking account of trends in work practices is always difficult. But as it stands, offices tend to be designed using market standards to cater for the worst case scenarios, rather than responding to typical needs. For example, the move to laptops and tablets, and an increasing tendency to have lower actual (‘effective’) occupational densities due to flexible working, means buildings designed to lower small power provision and densities will meet many occupiers’ needs. Yet because of a desire to be flexible and cater for the few occupiers who may have work practices requiring high effective densities and small power requirements, such lower requirement designs are not implemented.

*“you get built to an industry standard ... to appeal to a wide range of tenants. So ... if a tenant comes along and says ‘I want a massive internal gain’ [due to high occupancy rates and small power provision]... you can deal with it” (Consultant)*

This tying of flexibility to over provision is potentially problematic, because as the BCO (2013: 30) ask: “Should the optimum flexibility afforded by high specification, and required by a relatively small segment of the demand market, justify its blanket provision?” This matters because, as we show further below, blanket provision has significant implications for energy demand.

<sup>2</sup> Before the Second World War, 99 year leases were the norm, but this has reduced over time, along with the use of break periods, to mean that the average term of tenancy is now 6 years.

<sup>3</sup> <http://officeagentsociety.com/Images/Articles/Documents/AECOM%202%20BCO%20Scotland%20TMT%20Pres%20Nicola%20Gillen%20Final%20Summary%20for%20issue%201911.pdf>

**Conclusion 2: flexibility means meeting the needs of the most demanding occupier, however rare they are. This results in mass over-provisioning within commercial offices, with adverse consequences for energy demand.**

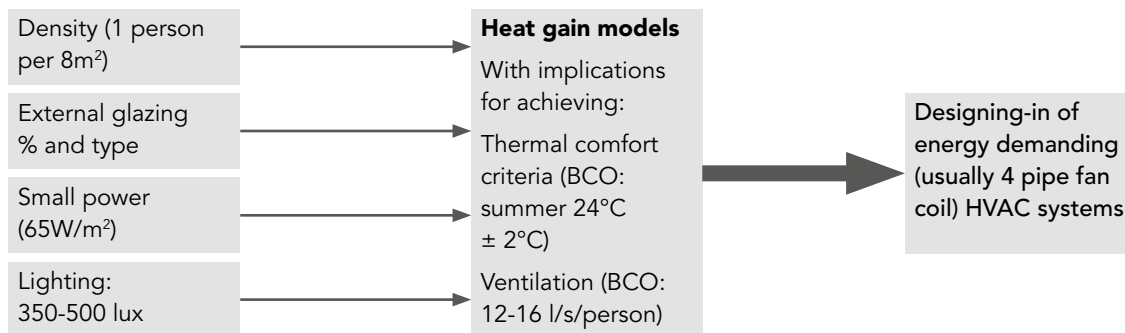
Our research suggests, then, that the meaning of flexibility and ways of achieving it need to be re-thought. The pressures generated by rental markets and diverse work practices and space budgets should not be met through a 'one size fits all' over-specification. Instead, smarter ways of generating flexibility are needed.

## LOCKING-IN HIGH ENERGY DEMANDING SYSTEMS

The over-provision and 'excess' capacity we have highlighted above does not always entail excessive energy consumption, if systems operate efficiently at part load. However, demands for excess provision matter when lower energy systems, such as displacement ventilation or chilled beams, are considered unviable in the context of market standards and demands for flexibility.

In energy performance models used for building design, market standards and demands for flexibility interlock and feed into heat gain assumptions. When combined, the heat gains associated with the assumed occupational densities and small power provision, floor to ceiling glass and bright lighting, result in modelled cooling requirements above levels that lower energy passive or mixed mode systems can easily provide. Thus a 'need' for air conditioning arises (see Figure 2) and designing-in lower energy systems becomes difficult, and often considered too risky or costly.

*"the way they're set up default ... there's some enormous peaks which dictates the choice of your systems which are applied universally across the building ... that is going to define your AC system and lo and behold you then have all of these hundreds of fans put in, grossly over-sized"* (Consultant)



**Figure 2**  
The lock-in of high energy demanding HVAC by market standards and ideas about flexibility

**Conclusion 3: Market standards and demands for flexibility interlock to encourage the designing-in of higher energy HVAC systems**

The hidden implications of over-specification need to be recognised more widely, particularly in terms of a tendency to rule out consideration of lower energy HVAC systems because of theoretical heat gain. Specifications that always assume high levels of occupancy and small power need (shown by the BCO to be extremely rare), and the desirability of features such as large expanses of glass need to be challenged to stop the interlocking effects outlined in Figure 2. This will lead to alternatives to the four pipe fan coil air conditioning system being viewed as viable in many more buildings than is currently the case.

## THE FUTURE OF OFFICE BUILDINGS AND ENERGY DEMAND

We have outlined here the way energy demand arises from:

1. The maximisation of development density and NIA and conformity with market standards requiring particular technical specifications and provision of the 'normal' aesthetics of a commercial office.
2. The ratcheting-up of these standards, and exceedance of standards in the search for flexibility and market competitiveness.
3. The locking-in of higher energy systems through market standards and ideas about flexibility that interlock and affect building design and servicing.

How then might offices and the process of designing and specifying them change in the future, and lower energy demand emerge?

## RECOMMENDATIONS

Our research and stakeholder discussions suggest that responses to the challenges highlighted in our report should involve 3 approaches:

- A new standard that is output not input based and which symbolises quality. In essence, rather than designing for theoretical performance (e.g. thermal conditions) or a particular level of provision (e.g. small power), guidance and assessments/badges need to focus on a building's performance in-use. Focussing on outputs in this way might unsettle the existing consensus that a 'one size fits all' model provides ultimate flexibility and is an optimum solution to the common 'unknown occupier' problem. This requires, however, two additional responses that would support such a change.
- More research on office work practices – this would allow office design to more closely reflect what it is that people in offices do, and what it is that they want or accept in terms of performance and provision. The current approach which leads to homogenised performance and ultra-high levels of provision everywhere at all times might be avoided if there was a richer knowledge base about how offices are used. This would help overcome current concerns that not providing homogeneous levels of performance and ultrahigh levels of specification is risky and may lead to offices that no one wants to occupy. Specifically, it would show what is appropriate in terms of performance and provision for different types of office work practices. This evidence base would allow revised approaches to design which target in-use performance assessments, that are more likely to be positive if the design is tailored to the work practices of occupiers. The feedback loop from occupation to future design needs, then, to be closed.
- Consensus formation in the market – with shared knowledge about appropriate performance and provision, and how this varies between occupiers, being the basis for acceptance of diversity in designs. Offices that are designed specifically to offer a diversity of specifications and a lower level of energy demand need to be 'sold' as distinct, quality products, through the engagement of all relevant actors. This means everyone involved in the commercial offices market, from architects and engineers, to developers and letting agents, and ultimately occupiers, have to share a new consensus about the value of appropriate provision and specification; a better understanding of office work practices is the starting point for developing such a consensus. But there will also need to be a lot of work to bring on board the various actors and negotiate a new 'normal' in terms of how offices are designed, assessed, valued and marketed.

**We elaborate on each of the three key recommendations further below.**

## NEW STANDARDS

A fundamental question exists about how a new output standard might gain traction. Is adaptation of existing standards possible, or are new standards required? BREEAM and EPC ratings seem unlikely to undergo radical reform, given their basis in a fundamentally input-focussed approach and respectively the complex commercial and regulatory interests surrounding each. Perhaps BCO Guidance might be the best tool to encourage change: it is input focussed at the moment but could perhaps most easily be changed to be output focussed. Work involving the Better Buildings Partnership is taking a different approach – focusing on developing a model similar to the Australian NABERS system. This may be productive, but we wonder whether it will be possible to replace the current reliance on BCO Guidance with anything tied to such a system. Might it be better to work with the existing and highly influential BCO to help develop a new output standard?

However, there might be an appetite in the industry for legislation and regulation as the only tools that can meaningfully drive change: regulatory anticipation is said to lie behind most meaningful changes in office designs in recent times. This suggests a role for an entirely new form of performance-focussed standard, imposed by the government, should not be ruled-out.

## RESEARCHING OFFICE WORK PRACTICES

Better understanding what people do in commercial offices (see trends identified in our interviews in figure 3) can play a crucial role in informing more appropriate designs. A richer knowledge base would encourage more unique designs and servicing tailored to particular groups of occupiers who share similar work practices and office requirements. Richer knowledge would also mean that designs will become less risky if they do not target performance and provision to meet the requirements of the 4-5% of potential occupiers with the highest demands. It would allow attractive and appropriate designs tailored to the work practices of occupiers who do not require the ultra-high performance and provision that characterises current commercial office designs.

Research should, then, focus on...

- Identifying different groups of occupiers who share similar work practices and how these practices might be best served in terms of performance and provision
- Empirically grounding the existence of claimed changes in technologies, work practices, hours and places of work, the diversity of space-planning, hotdesking and flexible working etc.
- Studying how evolution in the use of technology by different groups of occupiers is changing work practices, and in turn performance and provision demands. This means charting the impacts of developments such as flexible working and mobile working on the work practices performed in offices
- Considering the differences between peak demand and typical demand, and possibilities for designing for the typical rather than the peak. This means developing greater awareness of the way office work practices, but also building management practices, result in peaks that have certain timings or frequencies. This would allow a better analysis of the implications of not designing for the peak.

## CONSENSUS FORMATION

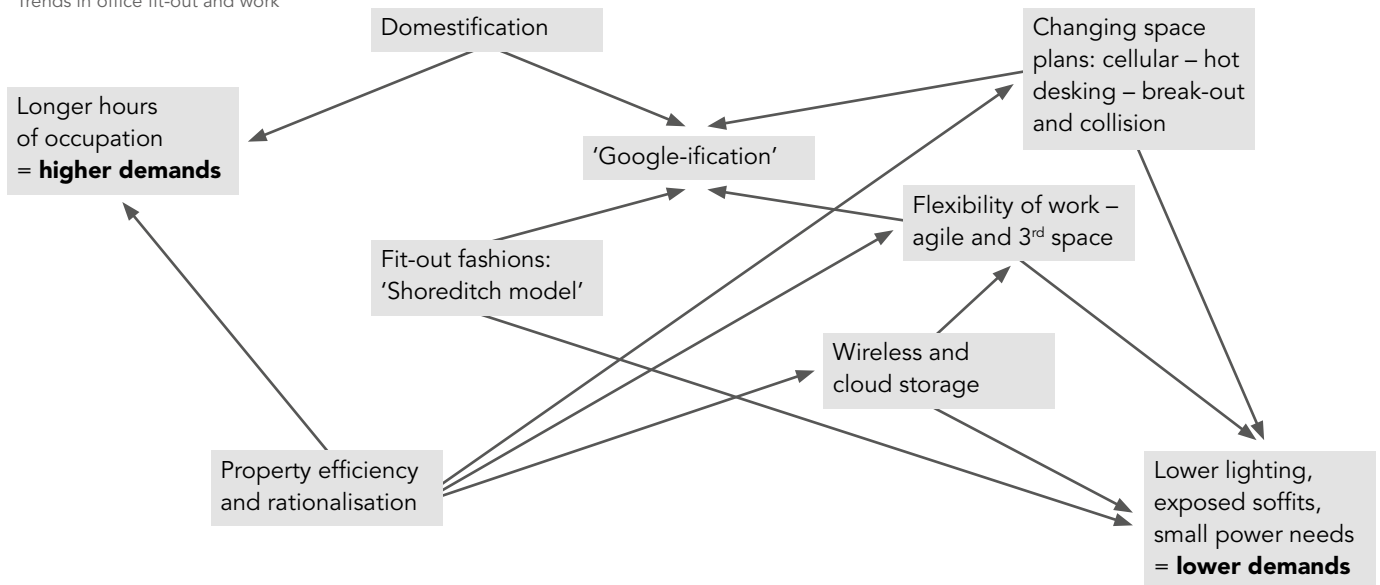
For lower energy modes to stand a chance in the market, the trends towards alternative building types, space plans and servicing options need to be turned into attractive typologies that the market not only accepts but actually values. At present, (in most cases unnecessary) ultra-high specification is valued. If appropriateness and different provision tied to assessments of performance in use were valued by all of the different actors in the commercial office market significant progress could be made.

One way forward would be to seek to develop a consensus about what is appropriate, on the basis of research and perhaps some experimentation. This would require all of the key players, from architects through engineers, developers and letting agents to develop a common understanding of 'appropriate quality'. This would require some significant commitment from a range of actors, perhaps led by organisations such as the BCO.

Alternatively, many of our interviewees suggested that careful regulation could drive the process. If regulation that focuses on appropriateness and inuse assessments emerges, in a way that is simple but effective in changing the focus of attention, change might be more rapid, less resisted and widely embraced.

It is, then, incumbent on those involved in commercial office design to consider which route is preferable, or indeed how a combination of consensus building and regulation might work together to invoke change. Our interviews suggest that the BCO and RICS are key institutions that could lead change in the thinking of the industry.

Figure 3  
Trends in office fit-out and work



Building	Build or refurb date	Location and tenancy	Standards designed to	Occupancy density designed to	HVAC	Small power provision: base and additional capacity	Interviewees	Area (given, converted, rounded)
A	2013	City/West End CBD	BREEAM Excellent, EPC B	1:10m <sup>2</sup> , 1:8m <sup>2</sup> achievable	4 pipe fan coil air conditioning	25+15W/m <sup>2</sup> : 40W/m <sup>2</sup>	Architects (3), M&E (1), Developer (1): 5	150,000ft <sup>2</sup> , 14,000m <sup>2</sup>
B	2011	City/West End CBD	BREEAM Excellent. BCO 2009	1:10m <sup>2</sup>	Displacement ventilation, mixed mode, opening windows	15+10 W/m <sup>2</sup> : 25W/m <sup>2</sup>	Architects (2), M&E (1), Letting Agent (1): 4	33,000ft <sup>2</sup> , 3,000m <sup>2</sup>
C	2013	Mid-town edge of CBD	BREEAM Excellent (2008). EPC B	1:10m <sup>2</sup>	VRF (variable refrigerant flow) air-conditioning	25+15W/m <sup>2</sup> : 40W/m <sup>2</sup>	Architect (1), M&E (1), Letting Agent (1): 3	64,000ft <sup>2</sup> , 6000m <sup>2</sup>
D	2014	Mid-town edge of CBD, single pre-let	BREEAM Outstanding. BREEAM 2008	1:8m <sup>2</sup>	Displacement ventilation, mixed mode	15W/m <sup>2</sup>	Architects (2), M&E (1), Developer (1), Occupier (1): 5	150,000ft <sup>2</sup> , 14,000m <sup>2</sup>
E	2014	Mid-town edge of CBD	BREEAM Excellent 2011. EPC B	1:8m <sup>2</sup>	Chilled ceilings and passive chilled beams.	25+10W/m <sup>2</sup> : 35W/m <sup>2</sup>	Architect (1), M&E (2), Letting Agent (1): 4	91,000ft <sup>2</sup> , 8,500m <sup>2</sup>
F	2014	City/West End CBD	BREEAM Excellent	1:8m <sup>2</sup>	Variable Air Volume (VAV) 4 pipe fan coils air-conditioning	25+20W/m <sup>2</sup> (all floors except 1 <sup>st</sup> and 2 <sup>nd</sup> which are 25+40W/m <sup>2</sup> ): 45-65W/m <sup>2</sup>	Architects (2), M&E (1), Letting Agent (1): 4	160,000ft <sup>2</sup> , 15,000m <sup>2</sup>
G	1960s, refurb 80s, 2013	City/West End CBD	BREEAM Very Good	1:8-1:12m <sup>2</sup>	4 pipe fan coil air conditioning	25W/m <sup>2</sup>	Architect (1), M&E (1), Letting Agent (1): 3	80,000ft <sup>2</sup> , 7,500m <sup>2</sup>
H	Late 80s, refurb 2014	City/West End CBD	BREEAM Excellent	1:10m <sup>2</sup>	4 pipe fan coil air conditioning	25+40W/m <sup>2</sup> for 20% of NIA: 25-65W/m <sup>2</sup>	Architect (1), M&E (1), Letting Agent (1): 3	68,500ft <sup>2</sup> , 6,500m <sup>2</sup>
I	80s refurb 2014	City/West End CBD	BREEAM Excellent EPC B	1:10m <sup>2</sup>	4 pipe fan coil air conditioning	15+25W/m <sup>2</sup> : 40W/m <sup>2</sup>	Architects (2), M&E (1), Developer (1), Letting Agent (1): 5	88,500ft <sup>2</sup> , 8,000m <sup>2</sup>
J	Early 80s refurb 2010	Mid-town edge of CBD	BREEAM Excellent	1:10m <sup>2</sup>	Displacement ventilation, mixed mode, opening windows	30W/m <sup>2</sup>	Architect (1), M&E (1), Developers (2): 4	246,000ft <sup>2</sup> , 23,000m <sup>2</sup>

**Table 1**  
Case study building summaries

**DEMAND executive summary** NEGOTIATING NEEDS AND EXPECTATIONS IN COMMERCIAL BUILDINGS

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