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Standards? Whose standards?

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ABSTRACT
Building standards, regulations and labelling schemes are instruments for reducing energy demand and carbon emissions, linking policy ambitions to market-based responses. In practice, their effects are complicated. In this paper we show how 'market standards' in the office sector are fostering escalating energy demand and favouring building designs increasingly disconnected from changing user needs. In 'black boxing' ideas about needs, standards powerfully and dangerously stabilize, and often escalate, concepts of 'normal' provision. Far from being neutral, standards are operating amid competing interests and ambitions in the market place. Processes of black-boxing, locking-in, ratcheting, reification, circulation and disconnection (the 'dark sides' of standards in action) are investigated to explore how they might be avoided. The paper provides insight into the role that market standards play in energy demand in the non-domestic (office) sector, through an examination of ten case studies of speculative office developments in London.

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Introduction: types and purposes of standards

In the market for buildings, as for some other consumer goods, a range of standards, regulations and labelling schemes are intended to nudge choices in a more sustainable, and in this case less energy-demanding direction. In reality, in buildings as with appliances, vehicles and so on, energy use and its resultant carbon emissions are rising. In this article, we use the findings from ten case studies of new office developments in London to argue that some of the standards that have been introduced have perverse and sometimes reverse effects.

Various standards are explicitly intended to help reduce energy demand and carbon emissions in UK office buildings including building regulations and in particular Part L2A of the Building Regulations 2010 on Conservation of Fuel and Power (Part L), the British Council for Offices' (BCO) Guide to Specification, Energy Performance Certificates (EPCs) and the Building Research Establishment's Environmental Assessment Methodology (BREEAM). The BCO guide is a toolkit of design specification advice that covers almost all aspects of office buildings, released periodically by the BCO, a voluntary membership-based organization that aims to 'research, develop and communicate best practice in all aspects of the office sector' (http://www.bco.org.uk/AboutUs/About-BCO.aspx). These can all be considered standards in that they act to limit possible actions to bring them into line with a set of aims (Faulconbridge, Cass, and Connaughton 2018), but they differ in several important respects. For a start, standards such as Part L and EPCs are strictly speaking regulations in that they are obligatory and defined by the state, and compliance with them is legally required. Others are 'market' standards, and compliance with them is theoretically voluntary – no one has to achieve a BREEAM rating or to follow the BCO's guidelines, however often market forces fuel a demand for them.

Both types of 'standards' match a more colloquial sense of the word seen in phrases such as 'standards are dropping' or 'keeping up to (a) standard'. Standards, broadly defined, convey a sense of shared conventions, industry norms, and expectations below which it would not be appropriate or wise to drop. Informal understandings of standards can be deeply cultural and binding through what some call 'institutional legitimacy'. Simply put, if you do not adopt the shared conventions of your culture, whether you are a member of a tribe or a building designer, your actions are viewed as beyond accepted norms of behaviour and you are considered an outcast or a fraud (Faulconbridge, Cass, and Connaughton 2018; Scott 2013). Adhering to standards in this sense is about basic intelligibility (designing something that others can understand as a valid 'office building'), as well as about communicating membership. Another colloquial meaning of 'standard' is as an adjective rather than a noun: 'we put in the standard number of toilets'. Here the concept refers to typical assumptions about normal, appropriate, or default provision. 'Standards' of this kind convey that those involved are following the rules of the game; not dropping below a taken-for-granted 'minimum' or exceeding what is 'normal'.

Beyond these senses in which building standards reflect more general linguistic uses, formal standards across society have several functions linking policy objectives to the operation of markets. Amongst these, and relevant for our discussion, are:

- Consumer protection: Standards often operate to provide a 'level playing field'. For instance education standards organize competition in the job market, and trading standards mean that dangerous products cannot unfairly undercut safe ones. Standards thereby enable market exchange whilst also ensuring public goods. For example, standards governing

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building design and employment practices achieve commitments to the health and safety of the population.

- Interoperability and functioning of systems and markets: Another function of standards is to guarantee the interoperability of different systems, for instance in converging forms of phone chargers or nationalized requirements for three (or two) pin plugs. These forms of standardization, voluntary or state-imposed, enable producers to design and sell standardized goods into a market where they 'fit'.
- Framing a market: In the case of (mandatory or voluntary) labelling schemes, standards make it possible to compare similar goods. This has the effect of itself creating the competitive market in a performative sense, as labels declare and certify that the goods are relevantly similar to the others between which choices can be made (Callon and Muniesa 2005; Cass 2017).
- Market transformation: Labelling standards thus also make it possible to compare and rank goods with reference to a particular characteristic such as energy efficiency, enabling it to become a salient in point of purchase decisions and thus acting as a means of 'market transformation' (De Jong and Parkinson 2013). This understanding of labelling standards lies behind much energy efficiency policy thinking in relation to appliances, cars and homes as well as office buildings.

Given these generalized understandings of standards in markets, we can further specify the particular policy roles of a variety of (public/private) standards in the building sector.

Standards as means of reducing energy demand and carbon emissions

The interface between government policy and the market is often fuzzy. In the UK buildings sector, as elsewhere, the balance between the state and regulation on one hand, and the market and voluntary action on the other, has been tipping away from top-down measures, enforcement, and (to cite popular discourses) the 'red tape' of a 'nanny state' towards 'market solutions' (Preston and Silke 2011). For buildings, this shift in the focus of standards aimed at effecting energy and carbon emission reductions takes three main forms:.

Relaxing prescriptions on industry

'Light-touch regulation' is increasingly the norm under current political regimes in the UK and elsewhere. This takes various forms. One is the tendency to introduce performance standards that specify ends and not means, and that allow market actors leeway to determine how these outcomes are achieved. A performance rather than prescription-based approach means that rather than banning design features or specific technologies with known higher energy demands, designers have to meet overall targets for (modelled) energy performance (Exeter University 2012). Consistent with this approach, and with moving 'beyond legislation', regulations are now subjected to intense consultation with market actors, followed by impact assessments in which the underlying assumption is that the state should 'do the minimum possible'.

Consumer choice

Labelling, badges and guidance represent forms of standardi zation working through consumer choice. The UK government's enthusiastic adoption of 'behaviour change', 'nudging' and making 'smarter choices' (Barr and Prillwitz 2014; Cairns et al. 2008; DEA 2010; Thaler and Sunstein 2009) reflects a model of governance designed to help and encourage consumers to make better choices for themselves. In this model, labels and badges correct 'information failures' in the market resulting in people making the wrong decisions (buying fast food or leasing energy demanding buildings) because they have imperfect knowledge. Thus the argument behind the use of sustainability and energy performance standards for buildings (e.g. BREEAM and LEED) is that they make visible, and comparable, qualities of a product to be factored into the decision-making of sellers and consumers that include in the building sector investors, managers and occupiers. 'Proper' specification and valuation of such features creates a 'green premium' to 'address such information failures and therefore encourage the integration of energy performance into the market for buildings' (Schiellerup and Gwilliam 2009, 802).

Market definitions of standards

The market itself produces standards. The BCO was established to stem an escalation of over-specification and provision in office buildings. Their guides on office design established an industry-wide understanding of the informal label of 'Grade A', meaning 'of high enough quality to attract high rental value'. With this understanding in place, increasingly expensive and energy-demanding specifications should be deemed unnecessary to secure the Grade A label, and thus secure returns on investment (Cass 2017), however energy was not a prime consideration in this market definition of 'quality'.

Summary

These trends help explain the growing uptake and significance of standards originating from the market itself, such as the BCO Guide, and successful multi-criteria assessments of sustainability criteria such as BREEAM in the UK or LEED (Leadership in Energy and Environmental Design) in the USA (Cole and Jose Valdebenito 2013; Goulden et al. 2015). BREEAM emerged from the Building Research Establishment (BRE) when that organization was still a QUANGO, but the adoption and use of BREEAM as the basis for other standards globally has happened since BRE's privatization in 1997 (Bordass and Leaman 2015). Of course, allowing standards to be driven by market actors runs the risk of capture by e.g. manufacturers of heating, cooling and ventilation systems, whereby the use of e.g. air-conditioning becomes almost essential to comply with increasingly demanding standards.

In the context of shifts in regulation towards market driven solutions, minimal standards of performance not prescription, and the mobilizing of choice as a determinant in change, there is an argument to be made that some standards help stabilize and actually increase energy demand and carbon emissions. Evidence for this was derived from the findings of a one-year, mixed methods research project into the dominant influences on office building design and the resulting energy demands, involving documentary analysis and interviews with engineers, architects, letting agents, developers, valuation experts and

quantity surveyors. The scale and methods of this study are summarized below and followed by a discussion about the effects of standards-in-use based on its findings.

Standards in action: a study of speculative office development in London

Research at the Demand Centre sought to examine how energy demand was designed into the form and servicing of higher-grade office buildings in London (http://www.demand.ac.uk/wp-content/uploads/2016/06/Demand-report-executive-summary.pdf). We studied ten speculative developments, i.e. designed without specific occupier-owners in mind, in the five years to 2015. This sample was chosen because research on energy efficient buildings has often focussed on 'best practice' buildings designed with long-term occupiers in mind (Cass 2017; Faulconbridge, Cass, and Connaughton 2018). By contrast, speculative developments are the dominant mode in the UK market for office buildings, with around 60% of office space currently under construction in London being un-let (Deloitte 2017). This trend is also increasing in other UK regional centres such as Manchester, Edinburgh, Leeds and Reading (Lambert Smith Hampton 2015). With speculative development as the new 'norm', it is worth exploring for what impacts it has in the drift towards unsustainability in building design. Our study sample included six new builds and four refurbishments, across different areas (or sub-markets) of central London, that ranged in size from 3,000 m^2 to 23,000 m^2. As 'Grade A' offices they were of broadly 'high' specification, in a central location, and demonstrably both 'sustainable' and corporate. The details of building characteristics and interviewees are provided in Table 1 below.

Our semi-structured interviews (Fylan 2005) were with fifteen architects, eleven mechanical and electrical engineers, fourteen developers and agents, and nine others including consultants. Most were directly linked to our case study buildings. We began with five exploratory interviews with leading industry experts known to the research team. These focused on questions about 'how speculatively developed buildings end up looking and working as they do'. These, we quickly discovered, were answered repeatedly with reference to a set of what we called 'market standards', that appeared to be non-negotiable and to drive design (Cass 2017; Faulconbridge, Cass, and Connaughton 2018). These were the focus of the case study interviews. In line with semi-structured interview methodology, specific interview schedules were generated for each building, but based around a generic question schedule summarized in Appendix 1.The findings relating to how standards-in-action operate to perversely increase the energy demands of such quality offices are described below.

Results: standards in action

Ignoring, for a second, some very important factors that (should) guide all architecture and design (site-specific features such as alignment, height restrictions and other planning concerns etc.), it seemed that the fairly similar appearances and servicing arrangements of our case study buildings were a consequence of following some actually quite inflexible rules of thumb, industry norms and design expectations. These were adopted because of the need to secure a set of badges and certificates considered indispensable for any development. Such commitments result in a 'check-list' for 'design for compliance', as its critics have called it (Bordass, Cohen, and Bannister 2016). With regard to energy use, the 'check-list' consistently included: meeting regulatory requirements (specifically 'Part L' of the building regulations); achieving a 'voluntary' BREEAM rating of Excellent (or above); securing an EPC (mandatory) rated at B or above (voluntarily chosen); and complying with the (also voluntary) BCO Guide to Specification. In other words, buildings designed for the 'high spec' market were expected to meet mandatory and voluntary standards originally intended to limit energy use and promote sustainable building design. Despite these laudable aims, various consequences arose from their actual use as a consequence of strategic action, the market's use of standards, and their falling out of synch with the changing office.

Strategic action

There was strategic use of energy modelling to demonstrate compliance. The qualities required to meet the requirements of Part L and attain good ratings in EPCs and the 'energy' category of BREEAM are linked together by methods and software which obscures processes of evaluation. Several interviewees stressed that strategic decisions about the type of software used, the inputs and assumptions required, the use or adaptation of default values etc., were sometimes taken to ensure that a building design achieved the scores required to secure a better rating, even when such decisions only affected the digital model: the resulting building remaining unaffected (Cass 2017, 12–13). Some would see this as 'fiddling the models'. These strategic choices are revealed in the following quotes:

> 'Comparing Tas and IES [Tas Engineering and Integrated Environmental Solutions' software packages] you could get a 20% difference depending . . . how you refine the . . . defaults' (consultant)

> 'BREEAM Excellent requires an EPC of 47 . . . The M&E consultant said "help I can only get to an EPC of 54" . . . What we did to achieve EPC was move from a level three model to a level five model,' (architects)

Such strategic decisions in digital design are 'black boxed' (Latour 1999) away from view, even though the processes are recoverable if challenged. In practice, once a standard, for example BREEAM 'Excellent', has been reached, nobody ever asks the question' of how it was achieved (letting agent). The same applies to the process of securing a satisfactory EPC.

This results in scores and labels that fail to capture likely actual performance. For an office *design* to be marketable requires only good *modelled* performance, rather than the evidence of energy performance in operation, particularly since the UK government drew back from applying Display Energy Certificates to commercial buildings, 'preferring to leave this to the market' (Cohen and Bordass 2015, 535). Such modelled energy use is often much lower (up to 2.5 times: Menezes et al. 2012) than the actual, meaning that 'there is little or no correlation between EPC ratings and actual energy performance' (Better Buildings Partnership 2012, 4), due to the 'performance gap' (Lewry 2015; Van Dronkelaar et al. 2016), and in speculative developments, end-use is even more unpredictable. This reliance on 'as-designed' performance, rather than measured performance in practice,

Table 1. Case study building summaries.

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

is potentially under challenge in the UK, with investigations of a performance-based certification process; the 'Commitment Agreement' (Bordass, Cohen, and Bannister 2016).

Market use of standards

Other unintended consequences relate to how standards operate in the market. For example, rather than keeping the lid on escalating expectations it seems that the BCO guidelines act as a 'ratchet'. Compliance with BCO Guidance is seen as essential to ensure the marketability of an office building in both office space leasing and investment markets. In this role it helps define an 'institutional specification' for 'prime' buildings (Guy 1998), of 'investment quality' (Guertler, Pett, and Kaplan 2005) or 'investment grade'. As one engineer stated, 'You wouldn't design a building to less than BCO standards . . . it's a huge cross'. Thus in practice such 'Grade A' specifications act not as an upper level, but as a baseline or floor which has to be achieved. Letting agents we talked to were explicit about this usage, saying BCO guidance was 'not used as a ceiling, it's almost used as the opposite, as a minimum guide'.

Furthermore, where BCO guidance was expressed as a range (e.g. fresh air rates of 12–16L/s/person), the upper figure was used with an assumption that 'more is better'. This was often exceeded, in a mode some referred to as 'BCO+': 'So building regs for fresh air is 10 litres a second, but BCO recommends 12 litres to 16 litres . . . the client said 16 litres plus 10%.' (M&E engineer). As described, the result is an unintended escalation of provision and thus overall electricity demand. Note that this is in contrast to much *domestic* ventilation provision, in which minimum standards are often adhered to (Hasselaar 2008); this may be a feature of the non-domestic sector, or even only of Grade A offices.

Standards out of sync

A third feature has to do with the relationship between standards and changing office practices. A number of the technical assumptions lying behind BCO guidelines, e.g. about expected small power loads, have been remarkably stable over the last decade, but the use of small power is typically far lower than that assumed in the guidelines (Menezes et al. 2013). Other embedded assumptions, e.g. about occupational densities and ventilation rates, suppose that space is being used more intensively, but again this is out of step with trends in office work and the use of office space (AWA 2015). The BCO's own research suggests that small power usage is well below the assumptions in their guidance (BCO 2014) and that effective occupation densities rarely reach the lower end (70%) of the assumptions they apply (BCO 2013).

In combination, these features underpin a systemic ratcheting up of expectations regarding peak loads, cooling requirements, and therefore the type and sizing of the mechanical HVAC systems that compliance with standards then comes to demand. Despite warnings that peaks should not be used to size equipment (BCO 2014, 4), the BCO guidelines are, in fact, being used to design for peaks of occupation, IT use, and energy use, and therefore cooling requirements, that are extremely rare in real world conditions. In short, there is 'a tendency to cater for . . . the worst-case scenario, everywhere, from day one' (BCO 2013, 6). This often results in higher baseload energy use based on over-specification (Better Buildings Partnership 2012). As detailed in Table 1, our case study buildings were all BCO compliant and met *or exceeded* the BCO guidance on specification. This means they were designed to provide as much *or more* heating, cooling, ventilation and other services, and typically anticipated higher densities of occupation and greater use of small power, than was set out in the guidance.

Discussion: standards and institutional contexts

The situation described above is not simply the 'fault' of e.g. BCO guidelines, nor is it a consequence of 'bad' design. Rather it is a consequence of the part that standards play within the market, and in particular, within the market for speculative office building (Cass 2017). We note that in other sectors such as the lower quality office market and non-domestic buildings, standards may instead be followed slavishly as bare minima in 'value engineering'. Standards have a particularly vital part to play in our study area of speculative design because designers are designing for unknown users. They help specify and anticipate the needs of unknown future users, and without some such assumptions, design is impossible. In this role standards are necessarily abstracted from the multiple 'realities' of use, and from the complexities of fluctuating occupational densities, lower power usage, and variations in practice. Far from being a defect, this is part of how they function. In the specific case of the BCO guidelines, for example, we found that interviewees acknowledged that the standards (should) help designers to find a middle course by maximizing flexibility without overproviding:

> If we design to the maximum . . . It's going to be very expensive . . . and probably will never be utilized in that way. But . . . nobody wants to be in the situation where you haven't made enough provision . . . where you go between those two points is . . . where the experience of BCO as a body . . . is very useful. (M&E engineer)

In summary, and as the above extract suggests, the institutional contexts in which standards are used (including guidelines, and especially the assumptions embedded in models, tools and design aids) mean that guidelines designed to limit consumption routinely result in 'over' specification, and higher energy demands, for three reasons.

First, they tend to 'lock-in' dominant designs and solutions (e.g. high levels of lighting, suspended ceilings and 4 pipe fan coil air conditioning) reinforced by developers and letting agents' conservatism and preference for known solutions. As one letting agent observed 'it's a sort of self-perpetuating cycle . . . It will only change if someone steps out of the norm and says we want our building to stand apart from the others.' In other words, 'market standards' can impede innovation where 'risk free' and 'tried and tested' strategies are preferred.

Second, they often rule out alternative (e.g. passive and non-mechanical) options for design and servicing because they reproduce a 'market ideal which equates quality with high levels of glazing, lighting, occupational density and small power capacities [which] results almost inevitably in air-conditioned offices.' (Cass 2017). Our interviewees pointed out that 'surveys of occupants . . . suggest occupants want natural ventilation, opening windows, . . . 70–80% do, whereas that's not what the

speculative market in particular provides' (architect), and that there is a potential for adaptive comfort with natural ventilation, given that 'heat gains are nowhere near what we expect them to be' (architect).

Third, they do not keep pace with changing practices. For example, the energy demands (and heat gains) of increasingly ubiquitous mobile technologies are far below those of previous generations of office technology, including the 'PC, VDU and printer', in relation to which many market standards were designed. As some pointed out, these innovations in digital office technology may mean that passive cooling systems are sufficient and additional air conditioning is not 'needed'. As one respondent put it: 'Are we designing buildings which are so locked into PCs and BCO . . . when in reality . . . shall we say its 5 watts . . . you've got a lot more opportunities to make sure passive cooling can achieve that' (consultant).

Fourth, they act as carriers of conventions. As has been discussed elsewhere (Shove and Moezzi 2002), the diffusion of standards involves the diffusion of the culturally and historically specific assumptions and conventions embodied within them. This is most evidently the case in relation to standards and procedures on thermal comfort adopted worldwide, such as ASHRAE 55. The key point is that design standards result in standard indoor environments. As people become accustomed to these conditions, they become 'normalized' such that anything else is seen as odd or deviant (Shove, Walker, and Brown 2014). Much the same applies to BCO or BREEAM guidelines, or WHO domestic temperature standards, all of which reproduce specific and changing interpretations of 'normal' conditions. In this way, expectations are 'transported' from one location and context to another.

Conclusion: the way forward?

The ways in which standards are used, and the institutional contexts in which they are embedded, are hugely important for the effects they have. As shown, standards have effect in different, co-existing 'worlds' of design, use, and investment, with unpredictable and sometimes unintended and counterproductive consequences. However, they are also 'necessary'; allowing design to proceed, and allowing designers to cater for future unknown end users. Are there ways out of this impasse? Is it possible to produce standards that do not have some of the problematically 'standardizing' features outlined above? And if not, is it possible to imagine a world without standards?

In recommendations to the BCO, we suggested some solutions, one being the development of multiple standards for multiple markets. Different sub-markets already exist in the speculative office sector, reflecting different locations and the likely sectors from which future tenants might be drawn. Given that there is existing knowledge of how tenants from different sectors occupy buildings, and of their different space requirements, uses of technology, and so forth, it might be possible to produce a suite of standards, rather than a single one-size-fits-all template. There are obvious limits in that 'bespoke' standards would clash with the value that single standards offer. In addition, and in the competitive markets we examined, if there was a range of standards and one was perceived to be 'the gold standard', it is likely that this would then become the 'standard' for all. Other possible responses would be for standards 'makers' to better articulate the assumptions they contain, perhaps providing standards with more detailed 'warnings' attached, or to shift to a performance-based certification such as Australia's NABERS (Newell, MacFarlane, and Walker 2014).

More fundamentally, this discussion highlights the importance not only of standards but of the institutional contexts in which they have effect. This raises the not original but still critical question of what buildings are 'for'. The function of standards is not the same in situations where buildings are owner-occupied and designed for specific uses and users, as compared to those in which they are best conceptualized as units of financial value and investment (Guy 1998, 2002). These are important considerations but it would be wrong to conclude that the solution is simply to 'think about the users'. Buildings are, and will remain, financial assets that figure in forms of market exchange, the operation of which often revolves around shared conventions and agreed forms of standardized description, measurement and provision (Callon and Muniesa 2005).

To conclude, and to return to the discussion with which this article began, we highlight the importance of appreciating the different kinds of work that standards do in different contexts. Standards are indispensable and important to guide the work that building designers and actors throughout society do. They are necessary abstractions that serve to create and transform markets. The specific 'market standards' we have outlined, in use, act as a form of regulation, imposing and circulating specific interpretations of 'need' and 'quality'. These govern the practices of architects, and may diminish or supress their knowledge and understanding of actual and potential patterns of use, of office working practice and of how these are changing (Faulconbridge, Cass, and Connaughton 2018). This is to be expected because of their very nature and function. However, we have shown that some standards – including those that seek to reduce energy demand – are likely to have the unintended consequence of *sustaining* and sometimes escalating present conventions (Shove 2017).

In this respect, far from being a solution, standards of the kind we have examined are better thought of as part of the problem. This is so because meeting ever more challenging carbon reduction targets depends on bringing normalized expectations to the foreground, and actively imagining future forms of well-being that are *unlike* those of today (Diamond and Shove 2016; Shove 2017); for instance those based on sufficiency rather than efficient provision of the same or greater services. This might require a re-thinking not necessarily of office buildings alone but of office work, and how it can be accomplished comfortably and effectively in an increasing variety of 'work*spaces*' both within and beyond 'the office' itself (Hui and Walker 2017). Such future workspaces are likely to be less not more standardized. Surely office buildings themselves can follow this demand for diversity and variety? To do so requires rethinking both what standards aim to achieve, and most importantly, how they play out in use.

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Appendix 1: Interview Schedule

Space does not permit reproducing the full interview schedule. Our initial open question was about 'how and why the building is designed as it is'. After outlining our hypothesis that 'buildings are never designed/engineered or fitted out completely 'from scratch' – there are certain ideas, rules, standards, guides and so forth that shape the finished building', we asked for responses to this, and for the interviewee's summary of the main factors influencing design. Follow up questions based on details of the building asked about: functional and symbolic spaces; lay-out (Corporate, Legal etc.); Occupational density; cooling, temperature and comfort; ventilation; small power provision, including lifts, Miscellaneous and Electrical Loads and catering/kitchens; glazing; and lighting. A final series of three open questions first asked 'in terms of the building, its form, services, and how it is imagined to be used, is there anything else that you think is relevant to how and why energy demand is what it is, that we haven't yet covered?' This was followed by a question about how all these factors might change in the future, and a final question on the use of 'standards' and how they might be improved. To finish the interview, subjects were asked to sum up their thoughts with a final quote.