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Climate change and our heritage of low carbon comfort

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ABSTRACT

This paper examines the viability of maintaining a heritage of low carbon comfort as an alternative to the energy intensive comfort regime of mechanical air conditioning. In many parts of the world, the carbon footprint of buildings is increasing significantly due to the widespread adoption of air conditioning. Current trends around indoor comfort are unsustainable, and alternative, less energy intensive comfort regimes need to be maintained or cultivated. To date, studies on this topic in heritage and preservation studies have focused on the architectural designs of 'passive cooling'. This paper seeks to expand this conceptualisation of 'cool living heritage' to incorporate other forms of material culture and comfort practice.

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Introduction

It is time to more critically interrogate cultural heritage as a resource for combating climate change. This paper pursues such paths by investigating the merits of conserving heritage based comfort regimes as an alternative to the increasingly prevalent, energy intensive paradigm of mechanical air conditioning. The issue of energy usage by the built environment represents a major challenge for developing more sustainable futures. It is widely accepted that for most countries around the world, around half their carbon footprint is associated with buildings. For those countries located in tropical and desert regions, the cooling of interior space has come to account for a very significant proportion of that energy usage, reaching 75% in regions such as the Arabian Gulf (Luomi 2012). In the hot and humid climate of Southeast Asia, energy intensive cooling methods have increased dramatically in recent decades. In the case of Singapore, more than half of the energy consumed by households (55%) is associated with the cooling of bodies and objects (37 and 18% on air conditioning and refrigeration respectively).¹ Similarly in Malaysia, research undertaken in 2014 by the Centre for Environment, Technology and Development revealed that 66% of household electricity consumption is associated with such cooling appliances.² In Saudi Arabia electricity consumption grew by 9% in 2012 in just one year with the housing sector accounting for half of that gain. Given the vast majority of the country's buildings have little or no insulation, air conditioning has become the primary cause of energy peak loading problems during the hottest months of the year.³ Air-conditioning (from here on also air-con or AC) thus contributes to the very significant energy rises that are now occurring on the back of high density urbanisation and an expansion in middle class cultures of consumption, and such trajectories mean that the developing economies of China, India and the Middle East will together account for

nearly two thirds of a global energy demand that is expected to grow from current levels by up to 40% in the coming two decades.⁴ It would be a mistake however, to assume that such environmentally problematic trends are limited to those countries located in desert or (sub-)tropical regions. Recent studies conducted by Shove, Walker, and Brown (2013) for example, explore the factors driving the incorporation of AC for regulating indoor environments in the more temperate climes of the UK.

Clearly then, and as we shall see in greater detail shortly, the issue of thermal comfort and its future represents a surprisingly significant, complex, and poorly understood, aspect of the carbon emissions challenge. As authors such as Crowley (2001), Pezeu-Massabauu (2012) and Shove (2003) have all shown there is a long history of comfort, one that is linked to ever increasing levels of energy consumption. In the case of indoor thermal comfort, the twentieth century saw dramatic increases in the amount of energy used for heating and cooling, as societies around the world urbanised and industrialised. The invention of mechanical air conditioning – the focus of this paper – has had profound social and energy consequences, and has led to norms and expectations around indoor comfort that many now argue are unsustainable.

Those working with the concepts of cultural heritage and preservation have a distinct, and potentially highly productive contribution here. Indeed, architects working with historic buildings have long argued conservation offers a multitude of sustainability benefits, including the preservation of structures designed to provide occupant comfort without recourse to modern energy intensive methods of mechanical air conditioning. Within this field, the principal focus has centred on the concept of passive cooling or passive design. Broadly speaking, it is an approach to architecture that incorporates the elements of nature, seasonal variations, and the possibilities afforded by micro-climates and local climatic conditions. As a vocabulary of design, passive cooling has ostensibly been formulated as the other of electro-mechanical cooling methods, and thus become a terminology of typologies retrospectively assigned to the ‘tropical architecture’ of European colonialism, the domestic buildings of Southern US states, or the traditional, vernacular, structures of the Middle East and North Africa, to cite a few examples. Passive cooling design elements such as verandahs, overhanging roof-lines, perforated screens, sun shades, and building orientation reduce solar gain and allow air flow. The benefits of cross ventilation are also maximised through the incorporation of vegetation, water and layouts that integrate indoor and outdoor spaces more seamlessly. Within this broad design vocabulary, regional variations arise in response to specific climatic conditions. Foruzanmehr and Nicol (2008), for example, focus on the hot, arid climate of Iran to argue that lessons can be learned from the principles of traditional built forms for rethinking the construction of buildings in the country today. They point to elements such as ‘thick high walls, wind catchers, courtyards, ponds, fountains, rich gardens and vaulted chambers’ as design principles that can be used to ‘upgrade existing settlements and to plan new ones’. Iran’s traditional structures also form part of language of regional vernacular architecture, with the wind tower perhaps serving as its most iconic element, as Coles and Jackson (2006) detail at length.

In Asia there is an extensive legacy of passive cooling design that is now being celebrated as the heritage of ‘tropical modernism’ and ‘tropical vernacular’ (Bay and Ong 2006; McGillick 2013). Architects such as Geoffrey Bawa, Charles Correa, Stanley Jewkes and Vann Molyvann have been celebrated for their public, commercial and domestic buildings that utilised an architectural vocabulary oriented around natural ventilation (large openings, stilts, heat escape devices), sun shading (overhanging rooflines, verandahs, solar orientation, greenery) and breathability (low heat storage materials, latticed windows, slatted floors). In the case of Cambodia, Vann Molyvann’s buildings of the 1950–1960s were shielded from the harsh climatic conditions through stilts and carefully positioned windows that avoided the path of the sun (Vann 2003). Like other architects of this period, he looked to designs found in the country’s vernacular architectural heritage for ideas. In Sri Lanka, Geoffrey Bawa’s architecture became renowned for its use of flowing indoor–outdoor spaces, and the incorporation of vegetation as an agent of cooling. From domestic homes with inner courtyards to hotels, schools and churches, Bawa’s designs were oriented by shade, water, air-flow and the rhythms of day and season (Robson 2007). Such buildings represented the accumulation of a deep knowledge about building

for the climatic conditions of the tropics that became popular across South and Southeast Asia in the decades leading up to widespread adoption of affordable air conditioning (e.g. Fathy et al. 1986). Of course it was an approach that extended far beyond the practices of the region's iconic architects, with cities throughout tropical and sub-tropical Asia characterised by structures oriented around their localised climatic conditions; a building stock that many contemporary architects and owners are now looking to for renovations and re-development through adaptive re-use. In cities such as Penang, Melaka, Phnom Penh and Singapore the shophouse typology of the late nineteenth, early twentieth centuries has proved popular for creating renovations that utilise airflow, internal courtyards, ponds and overhanging rooflines. Similar arguments have been made elsewhere in the world. Irulegi et al. (2014) and Ahmed-Shams et al. (2014), for example, have identified typologies of 'passive cooling' for Spain and the Southern United States respectively.

In summarising the value of this approach, the US based architect Carl Elefante points towards the importance of conducting proper life cycle assessment models for understanding the energy consumption of buildings (Elefante 2007). As Carroon (2010) notes in her volume *Sustainable Preservation: Greening Existing Buildings*, we need to properly account for the 'embodied energy' of a building in relation to its entire lifespan; a notion that seeks to capture the environmental debt incurred from the resource depletion and energy used in construction against the service life of the structure. But in the face of rapidly changing norms surrounding indoor thermal comfort, the potential benefits of extending the lifespan of a country's existing building stock can, in certain cases, extend far beyond a reduction in 'embodied energy' to include sizeable reductions in 'operating energy' too. A brief example illustrates this point. Today, in India alone tens of thousands of buildings are being designed and constructed in ways that are entirely reliant upon mechanical AC to provide occupant comfort. In the space of a generation air-con has profoundly changed how buildings are built and conceived and a number of architects within the country have looked to promote the conservation of those architectural forms that lie beyond this energy intensive paradigm, either because they were built prior to the widespread usage of AC or retain features of a low energy 'passive cooling' design philosophy.

Within what has become the broad church of heritage conservation, this architectural focus has come to dominate thinking about tradition based comfort regimes in largely exclusive ways. Given we are considering buildings and indoor spaces, placing the attention on the buildings and their infrastructure is to be entirely expected? Perhaps, but to propose a counter response we only need to look at the parallel issue of urban traffic congestion and the viability of alternatives to cars to realise that such debates have needed to move far beyond the technical issues of engines and vehicle design to incorporate questions of lifestyle, planning, road design, urban governance, and so forth. Accordingly, I would argue that in order to create a more productive dialogue about heritage based alternatives to the current energy intensive comfort regime, the current focus on the fabric of buildings and architectural design needs to form part of a more expansive discussion, one that seeks to sustain low carbon comfort practices.

Foregrounding the issue of comfort and how it is practiced rightfully (re)focuses our attention on people and objects, and allows us to use them as the starting point for creating and retaining more sustainable indoor environments. While much has been written about the value of historic non-air-con architecture, a critical perspective towards the potential these hold as low-carbon alternatives reveals important viability limitations. Through a focus on Southeast Asia this paper thus argues we need to engage with the entanglements of 'comfort practices' and 'low carbon heritage' forms – concepts that are explored at length here – if we are to more productively advocate for a reduction in the quantity of energy used by the built environment today. By applying such ideas to the question of heritage, the aim is not to jettison the building from the frame of analysis, rather integrate it within a wider material economy of everyday practice. The impetus for such efforts stems from the sense that low carbon comfort pasts represent a valuable resource for reducing the amount of energy consumed by the built environment. But to utilise this resource more effectively we need to critically understand these as bundles of materialities and practices that hold potential as alternatives to the ever increasing amounts of energy being produced and consumed because of mechanical air conditioning. By

opening up to these tangible and intangible pasts we can build a more expansive concept of ‘cool living heritage’, one that will be better placed to address the socio-material complexities that lie at the heart of thermal comfort. To demonstrate the validity of this line of thinking, it is first necessary to read AC as an important driver of physical and social transformation at the urban and national scale.

Indoor comfort and the rise of air conditioning

The rise of our modern air conditioning regime starts in the hotels and cinemas of the southern states of the United States, and the creation of leisure spaces that offered respite from hot summer afternoons. Back in 1998 Gail Cooper also revealed the early links between indoor comfort, energy and politics, tracing how the installation of air conditioning in the White House served as a form of lobbying by manufacturers. In the decades either side of World War II, the technology began to penetrate offices across the US and became part of the home of tomorrow (Cooper 1998).⁵ As companies sought to export their technologies, the globalisation of air conditioned comfort involved an increasingly complex mix of science, marketing, political lobbying and the emergence of new forms of architecture (Shove 2003, 2012). Indeed, the science of human comfort stretches as far back as 1922 with the first ‘Comfort Chart’ based on human subject responses to different combinations of temperature and humidity (Cooper 1998, 71). But the internationalisation of this knowledge regime was advanced most tangibly via the research of one man in particular Povl Ole Fanger. An engineer by training, Fanger undertook laboratory based experimentation into thermal comfort and perceptions of indoor environments at the Technical University of Denmark from the 1960s onwards; forming the highly influential International Centre for Indoor Environment and Energy in the late 1980s. Fanger’s thermal comfort equation centred around precise ideas about mean radiant temperature, relative velocity and air humidity in order to create ‘an optimal thermal comfort for man’ (Fanger 1970, 15). Crucially, it was a methodology of physiological comfort measurement that would come to be adopted and embedded in codes and standards around the world from the 1970s onwards (Brager and de Dear 2001; van Hoof 2008). Perhaps most influentially, the idea of 22C as the most comfortable temperature for human productivity was adopted by the American Society of Heating, Refrigeration, and Air Cooling Engineer’s standards (ASHRAE) for quantifying heating and cooling requirements in the determination of a building’s temperature and humidity levels. Crucially, this formed part of the socio-technical export industry of the US from the mid twentieth century onwards, such that 22C has become the norm for numerous countries around the world.

The science of Ole Fanger had a particular approach to the body. In the quest to scientifically regulate perspiration and its associated smells through the production of more precise indoor climates he identified two units of measurement: the first measured the scent emission of people and objects (the *olf*); the second assessed the total sensory ‘load’ produced by such scent emissions (the *decipol*). As Shove (2012, 65–66) explains,

In technical terms, an *olf* is equivalent to the scent emitted by an average person at rest, i.e. someone who takes approximate 0.7 baths per day, has a surface area of 1.8 metres squared, wears clean underwear, works in an office environment, is healthy and is a non-smoker ... Fanger’s *decipol* represents the air pollution from 1 standard person (0.7 baths/day, 1.8m², clean underwear daily, 80% use deodorant) ventilated by 101/s unpolluted air.

It was a laboratory based methodology to thermal comfort that came to define and prescribe international ideas of normality; such that culturally and historically blind definitions of normal bodies, normal activities and normal conditions were plotted and charted for the purposes of design and the efficient engineering of indoor space in buildings around the world.

But the impact of air conditioning’s global spread has been far bigger than just the standardisation of a comfort order. At a more profound level, and one that is much less well understood, it has also delivered significant transformation to the physical built environment of cities around the world, and the ideologies of progress and modernisation that have underpinned their development. The city-state of Singapore, popularly referred to as ‘the air conditioned nation’, is particularly revealing in this regard. After a number of early experiments with alternative technologies, mechanical air conditioning was

finally introduced in the late 1930s. The first buildings to instal the new technology were both cinemas. A 1939 advertisement of Cathay Cinema proclaimed that ‘The Cathay surely represents the final word in Modernity, Artistry and Efficiency’ (Chang and Winter 2015). It was not until 1949 before the first building, a nine-storey office tower, MacDonald House, was fully air-conditioned. Interestingly, during that same decade, previous deterministic theories about climate and civilisation imported from Europe were being softened and less racialised in significant ways, in part through emergent ideas that linked the rise of nations to success in controlling climatic conditions. It was an argument that gave architecture, and the control of interiors, a new prominence in the fate of countries seeking economic development in the aftermath of European colonialism. Indeed, it was suggested that those countries that could master their hot – and in the case of Singapore humid – environment would be able to shape their own economic and political destinies. In the story of Singaporean independence then, air conditioning would play an extremely prominent role. To quote the country’s first Prime Minister Lee Kuan Yew from an interview in 1999:

Air conditioning was a most important invention for us, perhaps one of the signal inventions of history. It changed the nature of civilisation by making development possible in the tropics. Without air conditioning you can work only in the cool early-morning hours or at dusk. The first thing I did upon becoming prime minister was to install air conditioners in buildings where the civil service worked. This was key to public efficiency. (Lee 1999, 5)

It was a perspective that would orient government policies towards embedding AC in the built environment over the coming decades. It thus formed part of a discourse of governance concerning urban renewal, new urban typologies that made air-conditioned comfort a central canon of post-independence socio-economic development. Much like other ‘developmental states’, Singapore would be strategically oriented towards attracting foreign investment from multinational corporations. The maintenance of ‘optimum’ temperature and humidity levels throughout the day was thus linked to productivity gains. But as with laptops decades later, the penetration of air conditioning into the home also meant bedrooms became sites of efficiency gains, wherein uninterrupted sleep was the backbone for a more productive workforce. In a few short years then, air conditioning had become integral to a model of urban and societal progress pivoted around a combination of comfortable consumerism and high productivity; a model that would be replicated by developing and industrialised countries alike throughout the world over the closing decades of the twentieth century. Equally, and as I have argued at length elsewhere, air conditioning has had an important transformative effect on the material culture of indoor spaces in regions such as Southeast Asia and the Middle East, negating the importance of previously popular forms of furniture, textiles, foods, clothing, vegetation, that formed part of climate responsive cultural practices (Winter 2013). Singapore is thus indicative of a widespread international phenomena, one that involves the enmeshing of air conditioning within both the economics and ideologies of modernity, development and nation building, and the habits, practices and materialities of everyday life. It is a set of relationships by which we now consume the vast amounts of energy cooling and dehumidifying interiors via AC noted earlier.

Comfort practices

The identification of such interconnections thus leads, I would argue, to the inevitable conclusion that the debate about the viability of low-energy alternatives, including heritage based ones, needs to move beyond the scope of architecture and the fabric of buildings. Indeed as Shove (2012, 61) argues, to alter our levels of energy consumption requires challenging the norms and systems in place at the regime level, rather than merely targeting the individual elements that contribute to that regime. In this case that means questioning the dominant comfort regime of mechanical cooling itself. To pursue such goals then we need to move away from a purely supply side analysis and its associated ideas about ‘consumers’, towards an understanding of how indoor spaces are appropriated, practiced and negotiated by their users. As Shove suggests, patterns and structures of energy usage are rarely as stable and permanent as they might seem, and a focus on forms of appropriation helps reveal how transitions in the use of energy can occur as daily practices change.

To expand the analytical frame then the idea of comfort practices is helpful here. Recent thinking around practice theory has highlighted the importance of interrogating relations between the social and material in ways that deal with their mutual entanglement in a more analytically substantive manner. By drawing on ideas around assemblage, such work sees this nexus and the idea of entanglement as the starting point of investigation (Hodder 2012). For Schatzki then ‘practices are the source and carrier of meaning, language, and normativity’, whereby everyday life is held together by and through particular material configurations (cited in Strengers 2012, 228). Clearly here we see the intellectual debt to actor network theory and the emphasis it gives to human, non-human relations (Latour 2007). The key realisation then is that – and as Shove, Pantzar, and Watson (2012, 10) put it – we need to not only have a ‘suitably materialised, theory of practice’, but also understand that materiality as bundles or configurations of multiple elements. The authors cite the practices of cooking, sports and driving to argue there is a need to critically focus attention on the links and breakages between the values associated with particular practices, and the materials (things, technologies and material resources), as well as the competences (those skills, techniques and knowledge) that make up social practices. They suggest ‘practices emerge, persist, shift and disappear when connections between elements of these three types are made’ (Shove, Pantzar, and Watson 2012, 14), giving private transport as an illustrative example of this analytical orientation:

If we take the practice of driving rather than the car or the driver as the central unit of enquiry, it becomes clear that relations between the vehicle (along with the road and other traffic), the know-how required to keep it in motion and the meaning and significance of driving and passengering are intimately related, so much so that they constitute what Reckwitz refers to as a ‘block’ of interconnected elements. Accordingly, novelty can come from any quarter and at any time. (2012, 31)

The key implication here is that we shift the point of focus away from technology or architectural design, to the practices of comfort. Strengers takes up such a perspective in relation to thermal comfort in the home, arguing that:

a practice theory perspective might view the increase in residential air-conditioning as the changing practice of household cooling, involving the complex co-evolution of material infrastructures (changing housing formats, central heating and cooling, the affordability and availability of the air-conditioner); common understandings of air-conditioning as a normal and necessary service, and changing notions of ‘air’ ‘health’ and ‘wellbeing’ associated with indoor climate and temperature; practical knowledge about how to cool the body and home; and rules about how to use and install the air-conditioner. This is distinct from accounts of the air-conditioner’s rapid diffusion in western societies that privilege processes of market economics (affordability and availability), cultural symbolism (the air-conditioner’s role as a ‘status’ object), or changing individual choices and lifestyle needs. (2012, 228)

In considering the issue of practice vis-à-vis comfort, these authors have primarily focused their critical eye on the regime of air conditioning itself, and its embedding in everyday life. By way of contrast, the key issue of concern here is how we might foster and sustain certain tradition based, low carbon alternatives to this regime: a cool living heritage.

Towards a cool living heritage of comfort practice

In building a broader picture of low carbon comfort practices we shift attention to the ways in which comfort is accomplished, enacted and reproduced over time. Moving from the building envelope to the occupant in this way opens up a whole series of questions about material culture and everyday practice. The issue of clothing offers a helpful starting point in that regard. The maintenance of comfort in the hot and humid climate of Southeast Asia has long involved knowledge about the thermal properties of textiles and clothing design. It is important to note that caution should be made in not producing deterministic accounts of such relations, as the histories of clothing and dress by cultural groups in the region, much like elsewhere in the world, are layered with the traditions of religion, class, gender, different ethno-cultural heritages and so forth. Historically, clothing in Southeast Asia was based around the width of cloth obtainable from a body-tension loom, and the availability of fibres such as cotton, hemp or silk. As Gluckman (personal communication, 2014) notes ‘The most basic



Figure 1. Restaurant, Melaka, Malaysia. Source: Author.



Figure 2. Indoor furniture, Penang, Malaysia. Source: Author.

garments – a hip wrapper and a multi-purpose upper body cloth (both used by men and women) were developed primarily to provide some protection/modesty as well as being practical for carrying babies, bundles, etc.’ In ceremonial or religious contexts, display was also a key factor shaping design and clothing practice. But as he also suggests, ‘in general all clothing in Southeast Asia (with the exception of the elaborate clothing of the elite which has had foreign influence for at least 500 years or more and is more focused on display than comfort) was designed to be comfortable and practical in the heat’ (personal communication, 2014). Of course, much like today, the practice of not wearing garments has also long been a tactic for minimising heat gain.

Further complication stems from shifting ideas about gendered and public/private clothing practices, with the increasing penetration of ‘western style’ dress over the course of twentieth century greatly altering norms about what, where and when certain attire is considered appropriate. The ‘spaghetti strap top’ for example, has become ubiquitous for women across much of Southeast Asia today, particularly in the more liberal urban contexts of Bangkok, Singapore or Hong Kong. The point here then is not to put forward essentialist assertions about traditional dress forms or particular garments, but to recognise



Figure 3. Covered walkway and furniture Melaka, Malaysia. Source: Author.

the role climate has long played in clothing choice and the practice of clothing. In so doing we can begin to identify where certain clothing practices which lie outside the regimes of comfort established by mechanical cooling have been superseded by those garments and forms of dress imported from northern hemisphere climates, and that are now reliant upon air conditioning for an 'optimal comfort balance'. The office can be cited as an indicative example here, where the 'international standard' for men of a wool/cotton suit with tie and tailored shirt has become a common convention, in large part on the back of Fanger's comfort regime noted above, replacing the practice of wearing looser, lighter garments such as the batik shirt.⁶ In the highly popular fabrics of Indonesian and Malaysian batik we also see the existence of knowledge concerning the weights of fabrics relative to seasonal variations. The lungi (India and Burma) or lipa (Indonesia) – a cotton tube-skirt garment that allows both airflow and easy readjustments in height above or below the knee – is worn in varying weights in accordance with the season.⁷ In citing these few examples then, the aim is to identify the practices of wearing certain textile fibres, styles of clothing, or seasonal based garments, which all point towards an accumulated knowledge of maintaining bodily comfort in certain climatic conditions (see also Dhamija and Eicher 2010; Khoo 1993).

We can think of fans in a similar way. Some of the earliest examples of hand-held fanning originate from China, with woven bamboo ceremonial fans dating as far back as the second century BCE. Accordingly, two books by Iröns (1982a, 1982b) document the extensive history of hand fanning in China and Japan respectively, indicating how the practice of cooling also became deeply incorporated into the cultural fabric of their societies, allowing users to hide emotions, demonstrate etiquette and manners, and identify social hierarchies. Interestingly, across a number of Asian countries fans – together with the shade providing decorative umbrella – became one of the accoutrements of royal and court culture, repeatedly featuring in ceremonies and processions. Hutt and Alexander (1992) pursue this theme in the context of Japan, tracing the development over time of folding fan technologies and the aesthetics of fan painting. In addition to identifying the role of the fan in court culture, they argue its usage proliferated in civil and ceremonial life, becoming integral to family ceremonies, military rituals, theatre and dance performances, as well as the myths and legends of popular storytelling. For Hutt and Alexander then, the significance of such associations is more than merely cultural symbolism, rather they argue 'the fan is so deeply rooted in Japanese culture' (1992, 26), far beyond the practical benefits they have long provided in the heat of summers.

As a parallel, in India a distinct culture of fanning emerged around the 'punkah' from the seventeenth century onwards. Typically attached to the ceiling and comprised of palm fronds or a

cloth-covered wooden frame, the punkah fan would be operated by a human operator or ‘wallah’ via pulleys and ropes. Now regarded as one of the iconic images of British colonialism, the punkah spread to other parts of Southeast Asia, and even as far as the houses and offices of nineteenth century plantation owners in the Southern States of America. Electrification in Asia led to the installation of the mechanical punkah and early versions of the electric fan familiar to today. Indeed, widespread electrification enabled the scale of fanning to move from the body to the room. The first desktop fan invented in the United States in 1882, lacked a grill to protect users from its two spinning blades. A few years later, Philip Diehl, a German immigrant to America, modified the motor developed for the Singer Sewing Machine and mounted an attached fan blade to the ceiling. As its use spread beyond factories and hotels in the southern states of the US, mass production gathered momentum, with firms such as Westinghouse exporting to different regions of the world in the early decades of the twentieth century, including the hotels, offices and homes of tropical Asia (Carmack 2009). Whilst the precise pathways taken by the different technologies of fanning across different societal contexts in Asia is difficult to track, and scope for worthy further research, it has remained ever present in the practice of maintaining bodily comfort until today. Whether designed to provide comfort at the scale of the individual or the room, fans intended for the hand, desktop, floor-standing or ceiling represent energy efficient alternatives to mechanical air conditioning.⁸ But crucially, their effectiveness stems in part from the material combinations within which they are used; an issue that leads us to the question of furnishings and furniture.

Homes and workplaces across the tropical regions of the world have long featured furniture for seating and sleeping designed to facilitate a through flow of air and the efficient dissipation of heat away from the body. As Figure 1 shows, the design of such furniture in Southeast Asia from the eighteenth century onwards was oriented around slats and meshing, and the ability to source local materials such as timber and rattan (palm). The significance of such designs becomes apparent when contrasted with the deep pile, feather/fibre cushioned furniture that has become common place in air conditioned environments today. With such furniture and bedding providing substantial amounts of insulation and minimal air-flow, body heat is retained, meaning mechanical cooling methods are required to maintain appropriate levels of comfort. A critical point to recognise here though is that the furniture designs illustrated in Figures 2 and 3 formed part of comfort practices that incorporated a much greater degree of thermal diversity. Rather than having interiors maintained at a constant 22C, buildings that have operable windows, screens and other openings allow air movement through an interior space, with ventilation connecting indoor occupants with the temperature and humidity fluctuations of their localised environment. Far from being the comfort regime tied to the cultural practices of bygone eras such as European colonialism, it is an approach to indoor comfort that remains viable in a multitude of contexts today. Indeed, as Brager and de Dear (2001) and Djamil, Chu, and Kumaresan (2013) have argued, within the international standards set by ASHRAE there is a need to move away from the narrowly prescribed norms of 22C and the thermal monotony created by the over-use of air conditioning, in favour of comfort adaptation models that are capable of embracing a greater degree of comfort diversity, fluctuation and choice. Such arguments also bring in to focus the topic of insulation and how materials feel in thermal terms as they touch the skin. Beyond the fabrics and fibres of bedding and seating, we might consider the role of flooring here. In contrast to carpeted flooring, timber and tiling offer cool surfaces to both sit and walk on, as well as an ease of cleaning. Flows of air create material entanglements between windows, dust and rugs, and the practicality of the latter stems from its ability to be (re)moved for cleaning.

Of course, alongside these material worlds are various accompanying traditions of thermal comfort praxis. Indeed numerous examples could be cited regarding habits and rhythms of bathing, working, resting or shopping in accordance with the time of day and local climatic conditions. Much like elsewhere in the world, comfort practices in tropical and sub-tropical Asia have long involved quotidian rhythms of movement around the cooler spaces of home, utilising the knowledge of shade, curtaining and the cooling effects of vegetation to find comfortable spaces. Nicol, Humphreys, and Roaf elaborate on this point further, suggesting such daily practices include:

movement between buildings, between rooms, around rooms, out of the sun, into the breeze, closer to the fire, with the blinds shut, with the curtains open and so on... People who regularly occupy a particular space will have a customary temperature that they associate with that place for a particular time of date or year. It will be part of a thermal pathway they follow each day, a pathway that at times may be too hot or too cold, but on average constitutes a well-understood pattern for a generally comfortable life. (2012, 69)

Questions of viability

The various examples cited here illustrate the broader analytical frame that can be constructed for considering indoor comfort as a materialised social practice, and the means for exploring alternatives to mechanical cooling. The fact that comfort practices have altered so much around the world in recent decades – principally through mechanical air conditioning – means highly challenging questions surround the viability of sustaining and promoting tradition based practices as low carbon alternatives. Clearly, and as noted earlier, a number of issues bear upon this, including the role AC has played in urban modernities, economic development and so forth. The logic of directing attention here to the smaller scale of everyday practice arises in part from the argument clarified by Shove, Pantzar, and Watson (2012) that transitions in this realm can also have a transformative effect at the meso-level, challenging and altering those assumptions and norms that give stability to societal values and ideologies. Clearly comfort practices have changed in significant ways over the course of the last hundred years or so and it is important to understand the criteria by which certain patterns emerge, are maintained or disappear. Air conditioning has had a transformative effect in this regard, altering the material entanglements and competencies surrounding indoor living. Today, there are numerous instances where the logics of air conditioned comfort appear to be locked in, with high-rise offices, hospital wards and surgeries, university lecture rooms and indoor shopping malls among those environments that now have extremely high thresholds for changing everyday practices and establishing new comfort regimes capable of dislodging air conditioning. We live entangled in material worlds: computers, door keys, cars. But we've also become entangled in technologies that remove other materials, namely dust, dirt and other out of place 'foreign bodies'. As Pezeu-Massabuau (2012) suggests we need to question some of the norms and ideas around comfort and its counter, discomfort that have come to so deeply embedded in everyday life today. The Coolbiz campaign initiated by the Japanese Ministry of the Environment in the early 2000s represents one such example, challenging workplace practices and the normative use of 22C for office environments.

In the face of the increasingly hegemonic comfort paradigm of air conditioning the question thus arises of how we might alter everyday practice. Undoubtedly this is a difficult challenge, and one that no single academic paper can fully address. Implicit to the approach proposed here however is the fostering of conversations which incorporate, but move beyond topics of architecture and design. Indeed, one of the key questions that stems from such a paradigm shift pertains to understanding the material and social configurations that enable particular alternative practices to remain in use. As Shove (2012) argues, for practices to be sustained over time they need to be performed successively in ways that maintain the interdependencies between their different elements. As we have seen, in this case, such elements include technologies of fanning, furniture, textiles and architectural design elements. It is here that raising public awareness about the energy implications of air conditioning plays a role. As the rise of the organic food movement or campaigns to reduce nicotine consumption have demonstrated, enacting productive changes in everyday practice involves targeting various strands of public life, including legislation, media coverage, advocacy and popular culture. The shift towards comfort practices is offered here as a step in such directions, one that can better connect expert knowledge with those who actually use buildings for work and leisure, as well as wider debates about sustainability and policies concerning the future of cities. More specifically, putting in place a more expansive understanding of low carbon comfort practices can serve as an important platform upon which the issue can be incorporated into other realms of public life and policy.

It is also equally important to address the factors that undermine long-standing comfort practices. To cite one example, we might consider how the shift from low-rise low density living to high-rise urban domestic and workplaces bears upon practice and breaks relations between particular elements, including furniture, fanning or clothing, as well as quotidian rhythms of work, leisure and rest. In considering the question of where and when it might be viable to maintain tradition based comfort practices, important questions about nostalgia and the romanticisation of the past come into view: a question that equally applies to the viability of retaining historic architecture. The point here then is not to create a nostalgia for a 'golden era' of sustainable comfort that has little viability within today's high-rise, high density cities. Instead, the aim is to point to those material and social entanglements by which comfort has been historically practiced in tropical and subtropical regions of world, in this case Southeast Asia, and examine the various factors by which some practices remain stable, while others disappear. By tracing forms of longevity and persistence, we can identify those elements – such as hand fans, operable windows, slatted furniture or the habit of sitting on the floor – and the relations between them, which remain far more common and widespread than might appear at first glance. The key task then is understanding how particular material arrangements, together with the social practices and their successive performance, represent viable alternatives to the energy intensive methods which have gained ascendancy in recent decades. To that end, Shove, Pantzar, and Watson (2012) argue it is analytically productive to interrogate such questions through the lens of relations of bundles. Accordingly, they ask 'how do bundles and complexes of practice form, persist and disappear? As elements link to form practices, so practices connect to form regular patterns, some only loosely associated, others more tightly bound' (2012, 17). One key question then in thinking about more sustainable forms of urban development in a region like Southeast Asia, pertains to the role AC plays in breaking the links between existing bundled comfort practices, and the degree to which old links might be restored, or existing elements can be brought into new, more resilient associations. Critically, accounting for why certain practices fade, disappear or remain popular in this way allows us to begin to anticipate the degree to which they might be maintained or revived as part of a low carbon comfort heritage that includes – but is not limited to – the forms of historic architecture that employ ideas about 'passive cooling'.

Conclusion

As we have seen, the future of comfort has a significant bearing upon questions of sustainable urban development and the consumption of energy by the built environment for many countries around the world. Accordingly, this paper has argued that low carbon comfort pasts – a cool living heritage – represents an important resource for fostering less energy intensive modes of indoor living. Highlighting the complex, multi-vector set of changes AC brings about begins to reveal the very real limitations of a discourse principally focused on non-air-con, tradition based forms of architecture. And yet, in fully recognising the value of design and structures inherited from a pre-air-con era within such debates, it has been argued that for these to be more viable as low carbon alternatives they need to be placed within a wider frame of tradition based comfort practices.

More specifically, it has been suggested that by placing architecture within this broader frame, it becomes part of a more expansive way of understanding how low carbon alternatives can be more productively maintained and supported. When it comes to built environment sustainability, we need to move beyond technological or engineering based prescriptions of sustainable design and create a more ambitious discussion about how we can use buildings in more energy efficient ways. If tradition based architectural forms can realistically begin to deliver forms of comfort that are viable alternatives to today's energy intensive methods of cooling then we need to look at architecture and built space as one part of a wider tangible and intangible heritage. More specifically, this means giving serious consideration to the question of whether those forms of material culture, urban sociality and everyday habit that formed under non-AC conditions can also be upheld or reinstated as part of the sustainability programmes and initiatives of today and in the future. To move in such directions, this paper has

argued for a more expansive, interdisciplinary approach to the challenges posed by air conditioning and the energy consequences associated with the global future of thermal comfort.

Notes

1. Source: Household Consumption Survey (2012, 175–182).
2. See <http://cetdem.org.my>.
3. See IEA (2014).
4. Source: US Energy Information Administration (2014).
5. See for example the 1939 New York World's Fair, which promoted futuristic clothing and interiors, imaginings that revolved around air conditioning (see Van Dyk 2007).
6. Recounting such shifts Roy Hamilton has suggested 'When I first went to Indonesia in 1971, the modern Western men's business suit and tie were unknown. These first began appearing on television anchor men and then, increasingly, with Western business interests in Jakarta. They are now the high status form of dress for men, yet totally inappropriate for the climate and essentially require air conditioning' (personal communication, July, 2014).
7. J Hamilton, personal communication, July, 2014.
8. See for Example Big Ass Fans – <http://www.bigassfans.com/au/summer-cooling>.

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