This is the authors’ final peer reviewed (post print) version of the item published as:


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The increasing importance of sustainability for building ownership

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ABSTRACT
Purpose — This study seeks to investigate the degree to which energy efficiency is incorporated into office building refurbishment and capital expenditure with the emphasis placed on a cost-benefit analysis from the owner’s perspective. Design/methodology/approach — In order to develop a research framework, a thorough literature review was conducted of three disciplines being construction technology, building refurbishment and property management. The study identifies differences between varying levels of capital expenditure to ensure an existing building is more energy efficient, with the emphasis placed on the cost of implementation and the potential for tenants to acknowledge the increased energy efficiency via higher rents. Findings — Office buildings have been identified as a contributor to global warming during the construction phase, however during the building lifecycle there is a greater contribution to CO2 emissions. Whilst various building designs and construction techniques have evolved to improve energy efficiency, the focus has largely been placed on new buildings where it is easier to incorporate change and innovative approaches. However, the proportion of new buildings constructed each year is relatively small in comparison to existing building stock, which requires regular capital expenditure to maintain and attract new tenants within a competitive marketplace. Practical implications — The increasing importance of energy efficiency affects the office market in a variety of different ways.
Originality/value — This paper identifies important links between the environment and the built environment, and the implications for office building owners.

Keywords: buildings, sustainable development, energy conservation

INTRODUCTION

The structure of the commercial property market is such that inherent barriers to energy efficiency exist. A significant proportion of the stock is owned by institutional investors who are unconvinced by the need to improve their stock and pass on running costs to tenants (Callender & Key, 1997). Capital values are not greatly affected by the amount of energy efficiency within a building and owners react by doing little or nothing to improve their property assets. Other barriers include poor information and professional conservatism (Scrase, 1999); the effect is to limit energy efficiency investment and undermine efforts to deliver energy efficiency in the sector. In an effort to improve energy efficiency many previous and existing Government lead programmes around the world have focused on the domestic sector, which is characterised by a large proportion of owner occupiers who have a vested interest in maintaining the capital value and condition of the property (Scrase, 2001). Thus, a substantial gap in research currently exists in the area of office buildings and the means of persuading owners to increase the uptake of energy efficiency.

Investing in real estate such as multi-tenanted office buildings is undertaken to acquire a reliable income stream. From an economic perspective an office building is a growth asset with two primary forms of income. Firstly, capital growth is anticipated due to the interaction of supply and demand factors where land supply is limited and the structure itself is a hedge against inflation. Secondly, property owners receive a regular dividend in the form of rent from tenants leasing space in
their building. Nevertheless all forms of property are affected, and at times adversely, by varying
degrees of obsolescence which in turn causes depreciation or a decreasing value to occur (Robinson
and Reed, 2003). Depreciation and obsolescence are unavoidable and can have an adverse affect on
the assessing the level of risk associated with a building, this in turn decreases the overall capital
value of a building. If the rate of depreciation and obsolescence can be slowed when the level of
energy efficiency is increased, this alone would be a strong case to embrace energy efficiency in
office buildings although there are other positive benefits to consider.

What is meant by energy efficiency in the context of this research? The study focuses on the energy
efficiency improvements that can be made to the fabric, envelope and services during refurbishment
of an office building to reduce CO₂ emissions and the role played by surveyors in this process. There
are a wide range of professionals who can be, and are, involved in such work, from development
surveyors, valuation surveyors, building surveyors, facility managers, quantity surveyors and
construction surveyors. If reliable information can be disseminated and there is a commitment to
advise all stakeholders about the social, economic and environmental benefits of energy efficiency, a
real contribution to climate change can be made. Professionals make a difference and clients will
generally listen to advice about energy efficiency, however the advice needs to be given. There is a
gradual change occurring in the business world where Corporate Social Responsibility (CSR) and
Environmental Management Systems (EMS, ISO 14000) are being adopted by an increasing number
of companies, and thus organisations will be more receptive to CSR and EMS with asset benefits
derived from improving energy efficiency in refurbishment.

There is substantial potential for the surveying profession globally to make a meaningful
contribution to combating climate change, especially by improving the energy efficiency of the
existing property stock during the property life cycle. The CBD precinct is of particular relevance
because each major westernised city has a centre business district, often with an aging stock of high
rise buildings (JLL 2005), with many of which having contributed to the provision of a poorer
environmental quality for city workers and, increasingly, city dwellers. As cities expand, improving
the quality of the stock is important for all stakeholders, investors, occupiers and policy makers. This
paper discusses the importance of energy efficiency in the wider environment and why this is an
area of growing importance. It examines the relevance of office buildings and how they contribute
to climate change, with the focus placed on office buildings located in the CBD. Furthermore, the
links between increased energy efficiency and property values are analysed both from a landlord’s
and a tenant’s perspective. This paper links the disciplines of energy efficiency and property,
followed by suggestions for further research in this emerging area.

ENERGY EFFICIENCY AND THE OFFICE MARKET

The link between the built environment, fossil fuel consumption and climate change was made
quickly. In westernised or developed countries buildings contribute approximately 50 per cent of all
carbon dioxide emissions (BRE, 1996; Croxton, 1994:27) and offer considerable scope for meeting
emission reduction targets through increased energy efficiency (BRE, 1996). CO₂ emissions from
buildings in the US equal 5 billion tons with the commercial sector emitting 740 million tons
(Croxton, 1994). Buildings are substantial greenhouse gas emitters; they produce more greenhouse
gases than all the cars on Australian roads (ABCB, 2001). Though CO₂ emissions can be reduced by
introducing filters to power generation plants, there is no reduction of energy consumption per se
whereas improving buildings thermally reduces consumption, costs to the user, and reduces a
nation’s CO₂ emissions to help fulfil international commitments such as Kyoto. Previous research
concluded that although readily available means of reducing energy consumption existed, the
‘business as usual scenario’ will not deliver sufficient reductions to meet the Kyoto protocol
(Australian Greenhouse Office, 1999; ABCB, 2001). Clearly steps need to be taken to be done to
promote wider acceptance and uptake of measures to reduce CO₂ emissions from the built environment.

Much research has focused on the technical ways in which reductions of carbon dioxide emissions may be achieved while other studies (Fisk & Rosenfeld, 1998; Leaman & Bordass, 1999) set out the social and economic benefits of sustainable construction. The general argument is that energy efficient buildings cost less to operate and have better internal environments for occupants, leading to healthier buildings that contribute to mitigating climate change (Scrase, 2001). Despite awareness of the need for conservation, consumption is increasing particularly in the office sector where CO₂ emissions are relatively high due to high electricity demand for heating, cooling and lighting (Scrase, 2001). The use of electricity is responsible for 89 per cent of commercial buildings greenhouse gas emissions in Australia (AGO, 1999). With a climate such as Australia, overall the breakdown of specific operational energy applications principally responsible for greenhouse gas emissions are cooling (28 per cent), air handling (22 per cent), lighting (21 per cent) and heating (13 per cent). Heating ventilation and air conditioning and lighting thus account for 84 per cent of commercial building sector greenhouse gas emissions and it is in these areas that the opportunity to reduce emissions lay (AGO, 1999). It is noted that Australia is a large continent incorporating eight climatic zones within its borders and that the breakdown of emissions related to specific operational use will vary across the climatic zones.

Building envelope performance has a significant impact on the heating, cooling and lighting requirements for commercial buildings (AGO, 1999). There is agreement that improvements in the thermal, daylighting and natural ventilation performance of commercial building envelopes will reduce greenhouse gas emissions. New construction has higher levels of thermal efficiency than any previous period and this has been achieved through improved standards in building and construction codes and regulations (HMSO, 2004. BCA, 2005). Globally westernised countries are increasing thermal standards of new buildings. Australia introduced mandatory standards for energy efficiency in residential property for the first time in 2005 and new regulations will be introduced in 2006 relating to commercial property (BCA, 2005). These improvements will deliver a building stock with higher levels of energy efficiency however, as Boardman (1991) demonstrated, the replacement of the existing stock of properties is so slow that it will take hundreds of years to bring all the stock up to current standards of energy efficiency. Currently in Melbourne the replacement rate for office stock is less than 3 per cent per annum (JLL, 2005).

The current predictions are that the commercial building sector in Australia is expected to increase its greenhouse gas emissions by almost 100 per cent from 32Mt of carbon dioxide (CO₂) per annum to 63MT between 1990 and 2010 under a business as usual scenario (AGO,1999). Under this scenario Australian emissions would significantly exceed targets established by Kyoto. The Australian position is that, though not a signatory to the Kyoto Agreement, Australia is taking action to reduce its rate of greenhouse gas emissions to 108 per cent of their 1990 level by 2008–2012. In Australia electricity accounts for the largest source of energy in the commercial buildings sector at 65 per cent followed by gas at 25 per cent, petroleum products 7 per cent and coal at 3 per cent. However because electricity results in larger emissions of CO₂ it results in 89 per cent of the total greenhouse gas emissions, whereas gas, accounted for only 7 per cent of total emissions. Undoubtedly substantial reductions could occur if Australian commercial buildings switched from electricity to gas as a source of energy, however a significant change before 2010 is unlikely and therefore emissions are likely to double.

When the proportions of energy use and greenhouse gas emissions are considered in the Australian commercial building stock, heating was the largest single end use at 33 per cent but is fourth largest with respect to greenhouse gas emissions (AGO, 1999). Cooling, lighting and ventilation is increase in
significance when greenhouse gas emissions are calculated and together account for 71 per cent of total emissions, although the actual proportion applicable to a specific building may vary considerably from the average. Table 1 shows the breakdown for the sector in end use and greenhouse emissions, and clearly the potential for reducing greenhouse gas emissions lies in tackling demand and usage in these areas. When all building types are considered the largest single source of greenhouse gas emissions in buildings came from offices, and therefore the focus for making significant reductions of emissions lies with this group. In order to deliver sustainability and meet Kyoto targets efforts to reduce emissions of the office sector is required.

REFURBISHMENT OF OFFICE BUILDINGS

Major office buildings undertake a major refurbishment approximately every 20–25 years. The drivers of refurbishment are to reduce vacancy rates, improve rental levels, re-grading assets from Grade B to Grade A and to mitigate against obsolescence; in essence they are financial. In the recent past many owners will opt for a series of minor refurbishments to lower the capex outlay and avoid access problems (Australian Property Journal, 2005). Australian office markets are relatively mature in comparison to other parts of the Asia Pacific region and are characterised by small amounts of new stock coming into the market annually. This market also has a stock of older properties and higher levels of refurbishment, hence the scope for improvements to the energy efficiency of the stock is correspondingly higher. For example the average age of Melbourne CBD office stock is 31 years, Brisbane CBD 25 years and Sydney CBD 28 years (JLL, 2005). Furthermore the average age since construction or last refurbishment is for Melbourne CBD 17 years, Brisbane 13 years and Sydney 19 years. Many of the office buildings in Melbourne and Sydney were constructed before 1960 and require refurbishment to remain competitive and offer significant scope in terms of improvements to energy efficiency (JLL, 2005).

<table>
<thead>
<tr>
<th>Use</th>
<th>Energy share by end use (rank in brackets)</th>
<th>Greenhouse gas emission share by end use (rank in brackets)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Heating</td>
<td>33 (1)</td>
<td>13 (4)</td>
</tr>
<tr>
<td>Cooling</td>
<td>21 (2)</td>
<td>28 (1)</td>
</tr>
<tr>
<td>Ventilation</td>
<td>16 (3)</td>
<td>22 (2)</td>
</tr>
<tr>
<td>Lighting</td>
<td>15 (4)</td>
<td>21 (3)</td>
</tr>
<tr>
<td>Office equipment &amp; other</td>
<td>9 (5)</td>
<td>12 (5)</td>
</tr>
<tr>
<td>Cooking &amp; hot water</td>
<td>6 (6)</td>
<td>4 (6)</td>
</tr>
</tbody>
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It is vital to examine existing stock (RICS, 1993), as work on and to existing buildings accounts for around 60 per cent of all construction activity with less than 2 per cent added to the overall UK stock annually (Chandler, 1991). Over the decade from 1995 refurbishments accounted for 60 per cent of all completions in the Melbourne CBD (JLL, 2005). Replacement of the stock is slow, and Boardman (1991) estimated that it would take until 2700 for the UK housing stock to achieve the levels of energy efficiency required by the 1984 UK Building Regulations. Similar low rates of stock replacement exist in the Australian office market (JLL, 2005). Part J, Energy Efficiency, in the Building Code of Australia was updated in 2005, however the overwhelming proportion of stock will be
inefficient since reasonable minimum standards of energy efficiency is only recent in the Australian regulations. It is not possible to deliver sufficient reductions in CO₂ emissions to meet targets or effect climate change through reliance on existing building regulations in any country, and consequently the onus is on those who influence stakeholders and professional consultants to deliver the message that improving energy efficiency in the existing stock is of paramount significance.

Refurbishment offers considerable potential for increasing energy efficiency during the entire building life cycle. In the UK refurbishment ‘is virtually half gross expenditure on building’ (Chandler 1991:167) yet little research focused on this area. There is a convincing rationale for energy efficiency in existing buildings. However, much improvement in energy efficiency in refurbishment is fortuitous (improvements in technology) or imposed (required by legislation) and the minimum to satisfy the building code (Croxton, 1994) rather than intentional (Cook, 1997). Thus research into office property refurbishment in the CBD and energy efficiency is relevant and necessary. AGO (1999) concluded that voluntary measures in the commercial building sector have the potential to produce higher levels of abatement than any of the current Government led policies or measures such as the building regulations. The reason being, that in the commercial sector there were low levels of penetration and application in the marketplace of policies and Government measures. Voluntary measures which focused on cost benefits such as short pay back periods and reduced running costs were likely to enjoy a higher uptake in the market. The report also concluded that the greatest opportunity for greenhouse gas emission abatement occurred in the area of lighting, which showed a potential reduction average of 70 per cent of total emissions. This conclusion is consistent with BRE (1997) findings in respect of the UK office sector. Refurbished buildings can achieve reductions of 50 per cent of greenhouse gas emissions on average however in order to maximise effectiveness the voluntary measures have to run alongside a programme of education and awareness raising.

Priority areas for abatement are perceived to be sectors such as Public Administration, community sector and retail. For example approximately 30 per cent of the Melbourne office stock is taken by Government and Public bodies. The major building types which offered the most scope for abatement were offices and hospitals, which provided evidence that the office sector is a valid area for abatement research. Within buildings a focus on reducing demand for electricity will result in the greatest levels of reductions. When building systems are considered, it is the lighting systems that offer the greatest potential for reductions within less than a 2.5 year payback period (AGO, 1999). The report concluded that equal priority should be given to new build and refurbishment as both offered the same potential for reductions however, it the authors belief that most building activity occurs in the refurbishment and maintenance of the existing stock and that the emphasis should be placed on existing buildings.

Another driver in the refurbishment of offices is that government and public administration and major corporate tenants are seeking buildings that demonstrate environmentally sustainable principles. In Victoria government tenants will only lease buildings with 4.5 star ratings under the GreenStar system, in New South Wales the figure is set at 3.5 stars. By 2007 owners wishing to sell office buildings will have to disclose to potential purchasers the energy consumption of the property as part of the due diligence process. It is considered that this measure will increase the pressure to provide energy efficient buildings. Owners can consider the performance of the façade and either utilise shading devices and or low ‘E’ glazing where appropriate. The incorporation of Building Automation Systems (BAS) or Building Management Systems (BMS) also provides an opportunity to increase the efficiency of the building management system to operate plant and services more efficiently with less waste (JLL, 2005). High efficiency chillers and variable speed drives on pumps or
fans offer a further opportunity to increase efficiency and reduce consumption of energy. The current view is that owners need to achieve AGBR ratings in the 3–3.5 star ratings in order to remain competitive in the market, clearly substantial amounts of the stock fall below this level.

RELEVANCE TO PROPERTY STAKEHOLDERS

Investment in office buildings in most capital cities is undertaken by varying types of investors including private and public companies, syndicates, listed and unlisted property trusts, government organisations and private individuals. Real estate is a complex economic good that consists of various components that collectively contribute to the value of a particular property (Fischer et al., 2004). All investors seek to maximise the return from their capital outlay, regardless of whether an owner-occupier or a landlord leasing to tenants. In recent times a higher level of accountability has been experienced throughout most levels of an organisation, with assets that do not contribute directly to the financial goals being outsourced. Property, and more specifically the corporate real estate component of an organisation, has received increased attention and it is commonplace for a government or a company to lease office space rather than purchase. Thus, the building component of an office building is often perceived as a wasting asset and relatively little is understood about the risk element that affects its value (Baum, 1991). A key issue in property investment is the wasting asset in the building component that depreciates over time and requires constant upgrading to maintain market position. This in turn affects the value of the building and requires further consideration.

VALUATION ISSUES

Economic theory commonly defines that the role of a business is to ‘maximise shareholder’s wealth’ and this readily applies to the capital value of an office building, which is viewed as a component of the shareholders’ wealth. Due to the relative infrequency of actual sales, the value of an office building is assessed by a property valuer who analyses and interprets current and historical information in the property market, as well as the individual characteristics of the office building itself. The valuation assessment is based on a hypothetical sale approach reflecting financial incentives for purchasing the property, and therefore the value is usually undertaken using the ‘income’ approach.

There are two primary methods associated with the ‘income’ approach, namely the (a) capitalisation of value method and (b) the discounted cash flow (DCF) approach with requiring further explanation.

(a) Capitalisation of income approach

The income of capitalisation method measures the future income of property ownership, where a property’s income and resale value upon reversion may be capitalised into a lump-sum variable (Appraisal Institute, 2001). The capital value is calculated by dividing the net operating income of an office building by the market derived capitalisation rate. Most importantly, the capitalisation rate and income multipliers measure the relationship between current income and current value (Fisher et al., 2004). Therefore the capitalisation rate reflects the market’s perception in regards to the future level of risk associated with the building, where a small change in the level of the capitalisation rate can have a substantial effect on the assessed capital value of the building. Closely associated with risk is the level of obsolescence and depreciation that affects a property, and consequently its capital value. In other words, if a building ages slower due to less obsolescence this will be reflected in a lower capitalisation rate. On the other hand, a building with a higher rate of depreciation and obsolescence will have a higher capitalisation rate. Using this scenario a property investor will seek to increase the capital value of their asset by taking corrective step to decrease the rate of obsolescence.
(b) Discounted cash flow approach

The discounted cash flow or DCF method projects cash flows into the future, often using a ten year timeframe. An advantage of this approach is that explicitly identifies the individual cash flows for each year in the DCF, which in turn allows all income and expenses to be analysed in detail (Fisher et al., 2004). In a similar manner to the capitalisation of income approach, the DCF has the ability to closely monitor the effect of obsolescence and depreciation on the building over an extended time period and how it affects the capital value (Appraisal Institute, 2001). If the effect of ageing is slowed with less obsolescence, a higher net operating income will be retained and consequently a higher capital value. Note both (a) capitalisation of income and (b) DCF valuation methods examine the relationship between the net operating income (the difference between income and expenses) and the market (via a capitalisation rate). Thus altering any of these variables will affect the overall capital value of an office building in one of three ways. Firstly, a landlord will seek to increase income via achieving higher rents where tenants will be agree to pay a premium for office accommodation in that building. Secondly, taking steps to decrease costs by increasing a building’s operating efficiency will result in a higher net operating income. Thirdly, decreasing the perceived level of risk will be reflected by a lower capitalisation rate and consequently a higher capital value. The value of a building is determined by analysing the relationship between the net operating income and the capitalisation rate. The landlord seeks to maximise the value of the building by maximising the income or lowering capitalisation rate, which in turn enhances the capital value of the office building. Thus, a landlord will focus on potential opportunities to increase the capital value via changing the perception of tenants in the marketplace and the perception of the collective marketplace towards the building.

**INCREASING ENERGY EFFICIENCY FROM AN OWNER’S AND TENANT’S PERSPECTIVE**

In an office building there are two primary groups who are affected by changes to the levels of energy efficiency of the building, namely (a) the owner or landlord and (b) the tenant. Each group has different financial incentives and affected by increased energy efficiency in a different manner.

**An office building owner and energy efficiency**

The owner of an office building is at all times focussed on maximising the capital value of the building, which is achieved by increasing income, decreasing costs or decreasing the capitalisation rate. Whilst the actual priority of increasing the capital value may vary between individual owners, the viability of the property investment will be severely threatened until a high level of financial stability is maintained. In other words, although it appears that many office building owners would like to become more energy efficient and recognise the importance of sustainable practices this is usually at a substantial financial cost. It remains that a strong case has to be made to ensure office building owners are rewarded financially for increasing energy efficiency. As well as being perceived in the marketplace as increasing corporate social responsibility, the priority appears to be centred in improving the value of the investment. In addition there are other incentives that may entice an owner to become more energy efficient, such as legislating and enforcing a certain requirement by each landlord or offering a monetary discount, or alternatively a rebate, for embracing the benefits of increased energy efficiency. An important factor also revolves on whether the lease structure is based on a ‘gross’ lease or ‘net’ lease basis. The former type of lease is where a landlord pays all outgoings associated with a lease, although with a net lease the tenant is responsible for all the outgoings. Therefore with a gross lease the landlord will benefit from reducing operating expenses, although with a net lease there is no difference to the landlord’s outgoing expenses. This is an important concept and can adversely affect the drivers influencing an owner to become more energy efficient.
A tenant and energy efficiency

In a similar manner to an owner, the primary driver behind a property related decision is focused on the financial aspects. In other words, a tenant often looks at the rate per square metre as the determining factor whether to lease space in a particular building. Whilst there are other influencing factors such as location and type/age of building, the actual leasing costs are critical. From this perspective there remains a barrier if a tenant will pay more for an energy efficient building, unless there are measurable benefits. At this stage two such benefits can be identified, namely reduced expenses and increased staff productivity. Reduced expenses will only affect those tenants on a net lease where they are directly responsible for their outgoings, and therefore a building with increased energy efficiency will favour tenants on net leases. Increased staff productivity can be achieved in an energy efficient building and converted into a monetary saving — examples include lower staff absenteeism, enhanced motivation levels for staff and decreased turnover levels. In other words, only certain tenants will benefit from relocating to an energy efficient building, although the additional premium added to the lease that a tenant would be willing to pay would be relatively small in comparison.

Implications for the property market

It is clear that gaining a better understanding about the wider implications of increased energy efficiency for office buildings will enable the property analyst, investor or stakeholder to make a better and more informed decision. Clearly all property investors share the primary goal of increasing the return from their assets, including an investment in office buildings. Nevertheless, the increasing importance of energy efficiency affects the office market in a variety of different ways and implications for the overall property market can be summarised under the headings listed below.

1. Effect on depreciation and obsolescence
An increased level of energy efficiency reduces the onset of various types of obsolescence, which in turn reduces the depreciation or loss in value. Whist this in an integral part of undertaking property analysis the positive effect of improved energy efficiency on obsolescence may be under-estimated when estimating the future income for income-producing buildings.

2. Reduction in overall risk
The inverse relationship between risk and return is a fundamental aspect of property investment and broader economics. An office building perceived to include an above average proportion of risk, such as unsystematic and tenant risk, will have a lower capital value. Therefore it can be argued that an energy efficient building may have risk which will be reflected in a higher value.

3. Competitive edge over other properties
Office buildings, both the sale thereof and individual vacant space in a building, are marketed in a fiercely competitive marketplace. Landlords and managing agents are seeking a competitive edge that distinguishes their product from others, therefore presenting an advantage over the opposition. Energy efficiency has been promoted as a successful means of promote a building either for sale or for lease, with other similar buildings often unable to achieve this and realise a higher capital value and/or leasing rates.

4. Forward looking office building
Improving energy efficiency in an office building can be perceived as acknowledging the fragile state of the environment, both now and in the future. Accordingly an owner who fully embraces the benefits of energy efficiency may be perceived in the marketplace as forward looking and progressive, rather than inflexible and being unwilling to change with the needs of society.

5. Influence on property values
There remains relatively little evidence that a prospective purchaser or tenant will pay a premium for an energy efficient office building or part thereof. Whilst this relationship will vary from building
The change in tenant efficiency is noticeable even in an office building. For example, a tenant will only be supportive of saving money via increased energy efficiency if they will receive a benefit, which will only occur if the tenant is on a ‘net’ lease. However, if the tenant has a ‘gross’ lease structure the catalyst for improving energy efficiency will come from the landlord.

CONCLUSIONS AND IMPLICATIONS FOR FURTHER RESEARCH

This paper identified important links between the environment and the built environment, and importantly the implications for office building owners. During this process the contribution of office buildings to CO₂ emissions and climate change was highlighted. Whilst this area is emerging research area, it falls between environmental studies and research into the built environment. Nevertheless, it is envisaged this paper has clearly acknowledged the contribution of office buildings to climate change and hopefully future research can fill this substantial gap in knowledge. It appears that the profile of energy efficiency is relatively low from a property perspective, many building owners, tenants and industry stakeholders in the marketplace possibly unaware of the wider implications of an energy efficient building. On the other hand an office building can benefit from improved energy efficiency levels in various forms including lower risk.

Professional bodies need to provide members with best practice information to enable those members to offer strategic professional advice with confidence, and this research encourages professional bodies to provide such best practice guidance regarding the refurbishment of existing office stock to members. Furthermore the research field can be broadened out in future to include other sectors of importance for energy efficiency, such as bulky goods warehouses, the retail and manufacturing sectors — all of which are currently increasing their energy consumption.

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