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Her PhD examined building adaptation, the MPhil explored the conceptual understanding of green buildings and she has an MA in Social Science Research Methods. She has published over one hundred refereed papers and books.

She worked in London as a Chartered Building Surveyor; as a Fellow of RICS and a member of API. She represents RICS on the Oceania Sustainability Group, the Oceania Education Standards Board and the NSW Committee. She is the International Federation of Surveyors Vice-Chair Commission 10 'Construction Management & Construction Economics'. Sara sits on the editorial board of four international journals.

Structured Abstract:

Purpose:

Retrofit of the existing building stock is essential undertaking to mitigate the effects of climate change and global warming. Pointedly most stock was constructed without consideration of sustainability. Sustainability was legislated in the Building Code of Australia in 2006, with minimum standards for energy efficiency applied to new build and some retrofit projects. Melbourne launched the 1200 Buildings Program in 2008 to deliver carbon neutrality by 2020 after Arup (2008) concluded that retrofitting two thirds of the stock would deliver a 38% reduction in greenhouse gas emissions.

Design / methodology / approach

This research used case study to examine what has been undertaken in the 1200 Buildings Program retrofits. This study had two aims which were; *to gain a deeper understanding of the improvements made to existing office buildings in the 1200 Buildings Program* and, *to undertake a comparison of current practices within the programme.*

Findings

The sustainability measures undertaken were largely focussed on building services and energy efficiency. There was less work undertaken to address water economy measures, to the building fabric and little work which addressed social sustainability aspects.

Research limitations

The cases reflect was what undertaken at given points in time and future practices may change as the economic and social environments vary. The study illustrates Melbourne practices which may or not be replicated in part or full elsewhere.

Practical implications

The research shows changes in practices are occurring and that energy savings are accruing to owners and tenants. Local practitioners are up-skilling themselves in the technical and environmental knowledge and skills necessary to retrofit the built environment to a carbon constrained future.

Social implications

Whilst the environmental and energy efficiency aspects of retrofit are covered in the 1200 Buildings Program social considerations are of lesser importance and these aspects should not be neglected.

Originality / value

No empirical research has been undertaken on the 1200 Buildings Program to ascertain how the built environment is being transformed to mitigate, as well as retrofit to, climate change.

Article classification: Corporate real estate management – research

Keywords: Sustainable retrofit, building adaptation, refurbishment.

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SUSTAINABLE RETROFIT IN THE MELBOURNE CBD: CONTEMPORARY PRACTICES.

INTRODUCTION

Retrofit of the existing building stock is an essential component in man-kinds attempts to mitigate the effects of global warming. Significantly most of the global stock was constructed with no consideration of sustainability. In Australia environmental sustainability for commercial buildings was legislated in the Building Code of Australia in 2006, with minimum standards for energy efficiency applied to new build and some retrofit projects. In 2005-6 commercial buildings were responsible for 53% of all greenhouse gas (GHG) emissions in the Melbourne CBD (City of Melbourne 2008).

The policy and legislative framework for sustainability in Melbourne

The City of Melbourne launched the 1200 Buildings Program in 2008 as a key strategy to deliver carbon neutrality by 2020. The Program aims to encourage sustainable retrofit and provide financial support through a partnership between the City of Melbourne and Sustainable Melbourne Fund (SMF). SMF administers the program's environmental upgrade finance mechanism. SMF manages the development and the operational delivery of the finance mechanism, whereas the City of Melbourne implements the 1200 Buildings program as a whole.

With 7.7 million square metres of office space and around 1800 commercial office buildings in Melbourne, a target of retrofit to 5.2 million square metres has been set. It is estimated that an average performance improvement of around 38% is required (City of Melbourne, 2008). The current targets are based on the Australian Building Greenhouse Rating (ABGR) standard of 4.5 stars out of a possible 6 stars though in 2012 the City of Melbourne stated that it intended to raise the target to 5 stars ABGR. The National Australian Built Environment Rating System (NABERS) rating is either a base building energy rating or whole building energy rating. A base building rating covers the performance of central services and common areas, which are usually managed by the owner whereas a whole building rating covers tenanted space. These ratings are disclosed when there is inadequate metering to obtain a base building rating.

NABERS Energy rates the energy efficiency of commercial buildings by comparing them against a set of benchmarks developed using building performance data. NABERS rates performance on a scale of 0 to 6 stars. A 6 star rating is awarded for market leading performance, and represents a 50% reduction in greenhouse gas emissions or water use from a 5 star rating. A zero star rating means the building is performing well below average and has considerable scope for improvement.

Under the *Building Energy Efficiency Disclosure Act 2010*, there are mandatory obligations applicable to many commercial buildings. The Act, implemented through the Commercial Building Disclosure program, forms part of a package of measures to encourage building energy efficiency developed by the Australian government. The Commercial Building Disclosure is a national program to improve the energy efficiency of office buildings and is managed by the Department of Climate Change and Energy Efficiency. The scheme shares similarities with the EU Energy Performance Certificates (Warren, 2011). Most sellers or lessors of office space of 2,000 square metres or more are required to obtain and disclose a Building Energy Efficiency Certificate (BEEC). A BEEC comprises a NABERS Energy star rating for the building, an assessment of tenancy lighting in the area of the building that is being sold or leased and general energy efficiency guidance. BEECs are valid for 12 months and must be publicly accessible on the online Building Energy Efficiency Register. From 1 November 2011 a full BEEC needs to be disclosed. Mandatory Disclosure requires minimum standards of energy efficiency and the aim is to encourage the market to take up greater energy efficiency (Warren, 2011). Analysis of the Melbourne commercial building adaptation market from 2009 to 2011shows greater levels of energy efficiency and that this policy appears to be delivering on its aims (Wilkinson, 2012).

Building Energy Efficiency Disclosure, NABERS and The 1200 Buildings Program together provide an environment in which sustainable retrofit is incentivised, encouraged and supported. This research sought to investigate the impact on practices.

Existing office buildings and sustainability

There are various office building typologies and energy profiles (Table 1). Buildings are evaluated in terms of likely energy consumption patterns on the basis of size, configuration, methods of ventilation and the presence of air-conditioning. However it also the case that Premium grade buildings in Australia (type 4 in Table 1) have the largest energy consumption and emissions but on a per metre squared basis lower grade offices, B grade, have higher emissions (PCA, 2008). On this basis the premium quality stock is less energy efficient and has poorer thermal performance.

Table 1: Office typologies and energy profiles

Office typology	Size	Configuration	Ventilation	Energy consumption
1 – Naturally ventilated	100-3000m^2	Cellular	Natural	Lowest
2 – Naturally ventilated	500-4000m^2	Open plan	Natural	
3 – Air conditioned (standard)	2000-8000m^2		Air conditioned	
4 – Air conditioned (prestige)	4000-20000m^2		Air conditioned	Highest (3x lowest)

When considering energy use within building heating, hot water and cooling are the largest consumers of energy across all typologies and are at the centre of efforts to reduce emissions. Energy use varies for tenants and managers and this creates some issues in respect of motivations for sustainable retrofit. The respective responsibilities are outlined in Table 2 below.

Table 2: Responsibilities for energy in office buildings

Energy use for Buildings Managers	Energy use for tenants
Heating and hot water (gas or heating oil)	Office equipment
Cooling (chillers, air-conditioning plant, condensers and cooling towers)	Catering
Fans, pumps and controls	Other electricity (print rooms)
Humidification	Computer communication rooms
Lighting	

(source: Author)

Clearly the managers have an opportunity to make significant energy savings. The savings which may be achieved can be as high as 70% but are typically 30 to 50% (City of Melbourne, 2008). A retrofit which takes building performance from average (i.e. 3 stars NABERS) to best practice (5 star NABERS) represents a 38% improvement in performance (City of Melbourne, 2008). The typical measures are shown in table 3;

Table 3: Typical retrofit measures for office buildings.

Measure	Improvements
Air conditioning	Attend to running times, volumetric capacity and operating pressure.
Office appliances	Use more efficient equipment and reduce standby losses.
Insulation	Improve thermal performance
Heating and ventilation	Use building energy management system (BMS), use heat recovery and perimeter heating for preheating
Lighting	Use energy efficient fittings, timers, linear fluorescent lights for interior, exterior and parking lighting
Water heating	Use efficient systems and technologies such as solar

(Source: Author)

Retrofit issues

In retrofit multiple attributes are important and are grouped as economic, location and land use, physical, legal, social and environmental (Langston, 2007). Above all, it is argued that although costs can be traded against social and environmental gains, retrofit has to be economically sustainable (Bullen 2007). Furthermore based on whether the intention is to occupy or lease, different features become more or less important. Owner occupied stock had higher levels of retrofit criteria compared to speculative designs and a greater return on investment over the whole lifecycle. Pre and post retrofit value is another success indicator with a Hong Kong study finding a positive relationship between retrofit and value (Chau et al, 2003). Another economic indicator is the level of vacancy rates pre and post retrofit (Swallow, 1997). Depending on building condition, quality can be increased where quality is measured by amenity features, services, fixtures and fittings (Bullen, 2007). However whilst it is possible to increase quality, rental and capital value; the capacity to upgrade depends on condition and location.

Physical characteristics determine whether retrofit is possible and desirable. Some buildings feature construction forms and materials making retrofit more expensive or challenging. Height, construction type and frame condition was important with steel frames being more adaptable because of the ease of cutting into beams. Floor size was significant in London retrofits where buildings with unusual floor plates or sizes were more difficult to retrofit and suited a limited range of users (Kincaid 2002). In addition the location of the services core is significant affecting the ability to sub-divide space. For example, a central location gives greater scope for sub-division whilst minimising corridor and circulation space. Whether a building is detached or attached affects the ease or desirability for retrofit. With less attachment contractors work faster and cause less disruption to users. Access or, the number of entry and exit points affects retrofit potential across a range of property types.

Location, considered in terms of proximity to public transport is an environmental positive. Where little or no public transport is available the amount of on-site parking is significant (Douglas, 2006). Swallow (1997) concluded that retrofit is affected by tenure because it affects the funds the party is willing to invest. For example, an owner has an interest in perpetuity whereas a lessee's interest lasts for the lease term. Institutional owners invest to maximise the return on investment and probably use professional consultants to advise on retrofit (Swallow 1997). Private owners may or may not use professional consultants and may reside overseas. They may hold property for many reasons, such as future development or for rental income or capital growth and may engage in less retrofit; though this is unknown.

Retrofit is affected by occupation, with single tenants when leases expire there is opportunity to retrofit, however, with multiple tenants, it is unlikely all leases expire simultaneously and the building may be partly empty (and not income earning) before retrofit can occur. Alternatively retrofit occurs with tenants in situ, which requires careful management. Historic listing protects architecturally or socially significant buildings for society (Ball 2002) but heritage retrofit can be more costly because of the expense of using traditional materials, techniques and craftspeople. Snyder's (2005) study found benefit in proactive policies and legislation in building retrofit and Bromley et al. (2005) found proactive policy and legislation enhanced the retention of existing stock. Hostile factors in retrofit include noise and asbestos which created social and economic barriers which drive up costs (Bullen, 2007).

The scope and extent of sustainable retrofit has increased and there is an overlap with social, economic and location aspects. For example proximity to public transport provides environmental, locational, economic and social benefits. The most significant environmental impact of buildings is the greenhouse gas emissions associated with energy use (Douglas 2006). Building Energy Efficiency Disclosure legislation and NABERS are described above. Green Star is the voluntary Australian environmental rating tool similar to BREEAM in the UK and LEED in the USA. Retrofit offers a chance to reduce energy and water use and to recycle, to harvest and re-use water.

Research aims

The key aims were;

1. *To gain a deeper understanding of the sustainability improvements made to existing office buildings in the 1200 Buildings Program in Melbourne, Australia.*
2. *To undertake a comparison of current practice to identify similarities and differences to retrofits in the 1200 Buildings Program.*

Research methodology

This research embodies the characteristics associated with qualitative research (Silverman, 2000). The main features of qualitative research are a preference for qualitative data with the analysis of words and images rather than numbers, featuring observation rather than experiment. This type of research has a preference for meaning rather than behaviour, a rejection of natural science as a model and, finally, a preference for inductive, hypothesis generating research (Silverman, 2000). This study involved the analysis of words and examined the research population's current practice regarding sustainable commercial retrofit as practised by participants of the 1200 Buildings Program. The aim was to gain a deeper understanding of contemporary practices with regards to sustainable retrofit. Given the low number of retrofits within the program at the time, a quantitative approach was not suitable as there were too few events to provide a statistically meaningful analysis (Silverman, 2000).

Research aim two was to compare current practices and to identify similarities and differences in the retrofit of sustainability measures. This research is exploratory research to identify what is undertaken with regards to sustainability when commercial property is retrofitted, and this aim was best achieved through a content analysis of the published case studies of completed 1200 Buildings Program projects. The City of Melbourne provides case study exemplars of the buildings within the 1200 Building Program on its website. The results were interpreted through a process of triangulation with the literature and previous Melbourne CBD research into retrofit practices undertaken by the researcher. All the cases posted on the official City of Melbourne 1200 Buildings Programme website in September 2012 were used in the analysis. There were ten projects in total.

Whilst interviews would have provided deeper and richer data for the researcher to work with, it was not possible to track down all the individuals involved in the projects as some had moved practices or left Melbourne. Retrofit is an activity which involves an extensive team of individuals including financiers, investors, regulators, owners, project managers, designers, engineers and occupiers and the time required to interview all stakeholder was prohibitive. Furthermore accuracy of memory declines over time and individuals recollections might be partial or incomplete at best, or inaccurate, at worst (Robson, 2003). The documentary and textual analysis provided an unbiased source of material to work with. Finally it was the intention to gain a deeper understanding of what had happened rather than what individuals thought about what had happened and therefore the case study approach analysing publicly available textual data was best suited to this project.

Case study research is either exploratory or explanatory (Robson, 2003). The data relates to the retrofit measures undertaken with regards to sustainability and the property attributes of the buildings. The analytical strategy adopted in this research is partially explanation building and partially pattern matching with previous patterns of building retrofit practices in the Melbourne CBD. The questions of internal and external validity are addressed as follows. Given that the primary purpose of the case studies was to observe and describe what measures had been undertaken, internal validity was not relevant (Robson, 2003).

External validity issues centre on the representativeness of the cases and how they can be extrapolated to the wider population. In this study, all the cases posted on the 1200 Buildings Programme website as of 28th September 2012 were analysed. In this way the research has external validity because all cases are considered. The analysis is a census of all ten projects completed at that date within the program for which data was available. Sampling was not an issue in this case and the findings are representative of the projects completed to date.

Results and analysis

The case study properties ranged from 24 to 116 years, as shown in figure 1 showing an even distribution in age. This shows that the Program is meeting the needs of retrofitting stock across a full age range. These properties are mainly located in the low prime areas though fringe locations also featured. They range in quality from Premium to ungraded and show the Program is able to cater for all building quality scales.

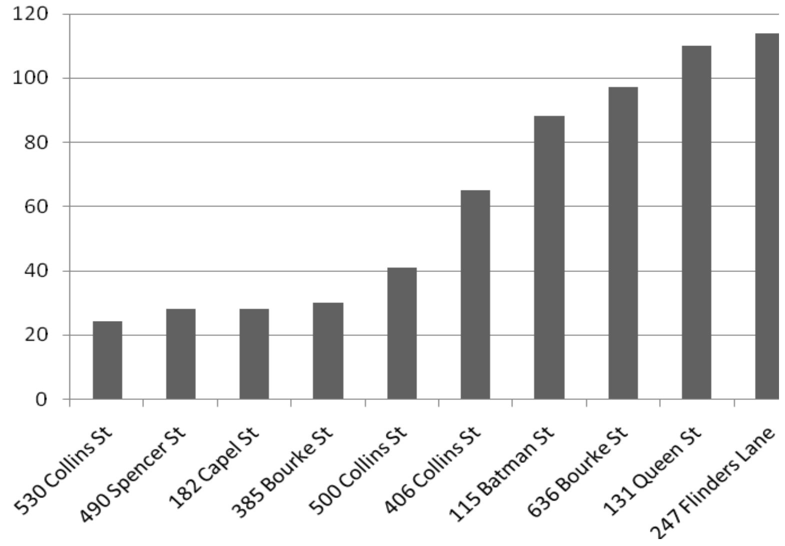

Figure 1 – Case study building age and address.

Table 4 summarises the retrofit objectives while the measures and the outcomes are tabled in appendix 1 and 2. Although the scale and age of the buildings varied many objectives were similar. For example, it was important in seven cases to attain a recognised market acknowledged environmental rating. Economic objectives were lower running costs and attaining returns on investment which shows that owners kept their attention firmly on financial considerations. Two of the projects were heavily dependent on Green Building funding and would otherwise have been reduced in scale or abandoned.

Table 4 Objectives of case study retrofit projects.

Case	Objectives
131 Queen St	Make safety and essential services code compliant. Achieve to a 4/ 4.5 NABERS rating. Reduce running costs.
636 Bourke St	Develop an environmentally efficient building in the use of energy and water. Minimise noise transfer in and around the building.
247 Flinders La	Achieve a minimum NABERS 4 star.
490 Spencer St	Create a zero GHG building
500 Collins St	Achieve A-grade building. Attain high environmental efficiency. Maximise tenant retention during upgrade to maintain optimum cash flow and provide pool of long-term tenants. Elevate tenancy profile by increasing the average size of tenancy, length of tenure and quality of tenant achieve a justifiable ROI.
406 Collins St	Improve energy efficiency. Achieve a 4 star NABERS energy rating. Reduce carbon footprint and use green power sources.
182 Capel St	Reduce carbon footprint. Reduce carbon emissions by at least 50%. Attain a 4.5 star NABERS Energy
115 Batman St	Introduce state of the art engineering services with very low levels of energy consumption. Provide comfortable working environment to enhance productivity

	Achieve 5 Star Green Star and 5.0 star NABERS Energy ratings.
385 Bourke St	Achieve 2.5 NABERS Energy rating.
530 Collins St	Achieve a 4.5 star NABERS Energy rating.

Measures

In all 70 measures were implemented across the ten cases (Wilkinson, 2013). These measures can be categorised as environmental and social measures. Many of the environmental measures were implemented because of the potential economic benefit which confirms Swallows study (1997). Most measures, 61%, related to the building services, whilst 73% related to energy efficiency reflecting the importance of energy efficiency in the attainment of NABERS and Green Star ratings and the aims of the 1200 Buildings Program. Furthermore the extent of energy efficiency confirmed Douglas' (2006) observation that energy is the most significant sustainability issue It also indicates poor energy performance in the existing stock.

Water economy measures featured less in retrofits. Overall 11% were water economy measures. The reasons could be that water economy is not as important as energy, or more likely, that due to stringent water restrictions imposed during the 10 year drought in the early 2000s many Melbourne buildings operate efficiently in terms of water. Measures to the building fabric were associated with energy efficiency. Opportunities for building fabric measures occur less frequently (17% of the measures), involve access challenges and disruption to occupants, as well as being expensive confirming Bullen's findings (2007). However once undertaken these measures offer a more long term solution than upgraded services which require maintenance and will be replaced typically within a 20 year period.

Social sustainability featured in four cases in respect of amenities provided to users in respect of improved internal environmental quality (IEQ). Overall 6% of measures had a social sustainability component. One project featured a roof top garden which provided a pleasant social space, however the rationale for inclusion also included environmental benefits of reducing the heat island effect, insulating the roof and reducing energy use (an economic benefit). Finally one project featured a building which housed small businesses which were driven by social justice and equity issues; thereby having a positive social sustainability contribution. Overall social sustainability has a lower profile within the retrofits.

Conclusions

The cases reveal a focus on energy efficiency driven by economic and environmental drivers. Water economy had a lesser importance in the cases, followed by social sustainability. Energy efficiency measures focussed on services rather than building fabric which one case study noted was of paramount importance, though more expensive. The comparison of current practices to identify similarities and differences in sustainable retrofit in the 1200 Buildings Program concludes;

- Physical issues were not related to fabric performance though it was acknowledged as important the costs of retrofitting fabric are higher. This reflects the current economic climate and timeframe for returns on investment. Other physical factors of note were hostile factors such as noise generated by the construction works disrupting tenants in situ. Noise issues identified by Bullen (2007) as hostile were challenges in some projects.
- Economic objectives were met in many cases with energy and water costs reduced, maintenance costs reduced in all but one case, higher rents recorded and yields achieved. In two cases there were concerns regarding returns on investment and these projects also relied on receipt of the Green Building Grant for viability. Economic issues such as yields and returns on investments (Bullen 2007, Ball 2002) were important critical success factors in some projects.
- Environmental outcomes were achieved and exceeded in some cases NABERS ratings exceeding targets. Energy and water use was reduced in all cases and one building is zero carbon on sunny days.
- Social outcomes are positive with higher productivity and improved IEQ measured in one post occupancy evaluation. Staffs were also noted to be 'happier' in the post retrofit buildings. The green roof had worked well and the hotel building attracted some visitors on the basis of its 'green' credentials.
- Management issues which arose during the retrofits were the difficulties of getting multiple owners to agree on retrofit measures, the need to communicate effectively with and educate tenants about the process and projects, the need for strong project management, the need for advocates to promote ESD, the need for independent commissioning agents to verify data. Retention of tenants as also positive in the cases. In some projects the aim to increase occupancy was achieved the level of vacancy rates changed pre and post retrofit (Swallow, 1997).

More general findings were;

- Owners were motivated by different drivers, and the predominant initiating party was built environment consultants who sought to develop knowledge and experience in sustainable retrofit whilst upgrading their offices.
- Fringe locations featured more prominently in the cases compared to general trends and earlier studies (Wilkinson 2012) however low prime is where most retrofits occur and this compliments earlier study and general practices.
- In the 1200 Building Program there is a preference for non-heritage buildings confirming the additional requirements for adaptation noted by Ball (2002) may deter owners from adapting until absolutely necessary.
- Ungraded buildings were most likely to be worked on (50%), followed by B grade stock (20%) and the 1200 Buildings Program is reaching all grades of stock which is vital if the whole stock is to be adapted over time.

Substantial improvements have been afforded to buildings within the program in terms of energy efficiency. Fewer improvements are focussed on water and it may be that some buildings are efficient due to the drought which affected Victoria for a 10 year period during the 2000s. Significantly Snyder's (2005) finding that there is a relationship between proactive legislation and change in the adaptation market is supported in this study; here the realisation is buildings with enhanced sustainability.

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Appendix 1 Case Study -Sustainability measures implemented.

Case address	Measures
131 Queen St	Sealed roof membrane. High efficiency chiller Variable speed drive (VSD), air handling unit (AHU) Economy cycle, Digital Building Management System (DBMS) Rooftop garden New fire panel and HVAC system, and Install sensors and T5 light fittings in common areas.
636 Bourke St	Insulation to reduce the heat / noise transfer. High star rating HVAC inverters, with sensor controls. Heat as required gas water. Hot water reticulation system. Low flow taps and showers. Fluorescent or LED lamps. Replenishable dispensers in hotel rooms for guest complimentary toiletries. Organic waste and frying oil disposal for conversion to bio-diesel fuel.
247 Flinders Lane	Financing the retrofit Optimum identifying environmental improvements
490 Spencer St	“Virtual double glazing” PV solar supplies 20% to 100% of building power. Energy efficient lighting. 100% Green energy. Water efficient appliances. Reuse and recycling of building materials. Web-enabled Building Management System
500 Collins St	Energy efficient VSD chillers. Gas fired boilers. Chilled beams (passive and active). Solar panels servicing 25% hot water requirements. T5 light fittings. Water tanks collecting rainwater and condensate for landscape irrigation. Waterless urinals and dual flush cisterns. Flow restricting devices on all fixtures.
406 Collins St	Variable Refrigerant Volume AC system. Zoned floors. Economy cycle dampers. Automated night-flushing. Roof sunshade. Internal and external shading in courtyard. Motion light sensors in stairwells and lifts. High efficiency lighting in common areas. Sub-metering system. Web enabled building management control system
182 Capel St	Automated opening windows, connected to economy cycle and control system. Automated external blinds. Gas-fired VRF gas heat pump air conditioning. LED and fluorescent lamps connected to intelligent control system. Rainwater collected in (Stage II) tanks located in basement for WC flush and irrigation. Green wall (vegetated façade). Bokashi buckets for waste disposal, green façade nutrient. Intelligent component control systems. Additional building sealing and insulation. Ceiling fans. Fit-out and construction with recyclable materials.
115 Batman St	Complete re-construction within existing façade. Highly insulated building shell. Chilled beams in the ground, 1st and 2nd levels. VAV Economy cycle on 3rd level. High efficiency gas boiler for heating. High efficiency luminaries. 15,000 litre rain water tank. Solar panels for water heating.

385 Bourke St	Upgraded BMCS. Variable speed fan drives. Economy mode. Lux meter sensors. T5 lamps. Quantum heat pump units. Flow restrictors in washrooms. Commingled recycling program. Metering.
530 Collins St	None listed

Appendix 2 Case Study - Project Outcomes.

Case address	Outcomes
131 Queen St	40% reduction in energy costs predicted. Green roof top valued by users. Savings of A$50,000 p.a. anticipated. Key issue was the complex ownership structure.
636 Bourke St	Energy consumption reduced to 36 Mj/day. Water consumption is 123 litres/day. Savings from reduced water use and water heating costs is significant. Green attributes make it attractive to guests. Maintenance costs may be higher than previously. Energy efficiency of fabric is paramount and should be addressed before services are changed.
247 Flinders Lane	None listed
490 Spencer St	On sunny days building is zero carbon. Water consumption is being tracked to compare to similar stock. Financial savings from better maintenance are considerable. Higher rents achieved post retrofit and lower running costs
500 Collins St	Energy was modelled to achieve a 30% reduction in AC, 50% reduction in lighting and 15% reduction in HW usage. Water modelled to achieve 40–50% savings. Sustainability Victoria productivity study in 2007-08 found a 39% reduction in sick days and 9% improvement on typing speeds. Reduced maintenance costs Rental value of the refurbished space has increased. Occupancy rate did not fall below 70%, and building has fewer tenants now. Gained a 5 Star Green Star rating. Important to communicate with tenants. Need strong project management leadership. Manage and control noise and temporary service shut downs. Engage an ESD consultant to advocate. Engage independent commissioning agent.
406 Collins St	Energy performance should be halved or as low as 25%. Achieved 5.0 NABERS Water rating. Educate tenants to accept warmer ambient temperatures in summer and cooler in winter for savings. With HVAC improvements and installation of BMCS maintenance will be faster and less costly. There will be significant energy savings, but the owner is unsure of direct financial ROI. Viability of the project hinged on the Green Building Fund grant.
182 Capel St	A NABERS rating was to be conducted at the end of 2011 with target of 4.5-5 star NABERS Energy. Water reductions saving 900 litres/day. Tenants are happy and have decided to stay. Mechanical maintenance costs reduced from $3,200 pa to <$1,000 pa. Lighting maintenance reduced from $1,200 pa to $500 pa. Project needed an 8% yield on investment which has been achieved to date.
115 Batman St	Chilled beams work well and are superior to the third floor VAV system. Base building lighting consumes less than 2 watts per m^2 per 100 Lux. Building performs better than 5.0 stars NABERS energy. Very positive feedback from staff about the work environment. Maintenance straight forward.
385 Bourke St	41% reduction in CO_2 and a NABERS energy of 3.5 stars. 3.5 Star NABERS Water achieved. Works brought up maintenance issues which are being addressed. Increase in NABERS Energy rating opens up the building to a larger market of tenants.
530 Collins St	None listed