COMMON LIST OF IMPROVEMENTS *PRE-APPROVED* FOR ENVIRONMENTAL UPGRADE CHARGES

SUSTAINABLE MELBOURNE FUND

Improvement	Environmental Upgrade Benefit (+)	System	Sub-system	Description	Eligibility Requirement	Further Information	Effective Useful Life (EUL)	Source for EUL
Building Envelope								
BE 1 – Reduce Building infiltration/ exfiltration	Energy +	Envelope	Building infiltration/ exfiltration reduction	Uncontrolled infiltration/exfiltration through the building envelope can course discomfort and energy wastage. Methods to decrease infiltration such as door, window and other facade seals, and exhaust duct shut off can reduce unnecessary infiltration and leakage of conditioned air. Pressure testing should be carried out as part of the building assessment and feasibility study works to determine the leakage conditions and likely impact on HVAC energy consumption. In buildings without mechanical ventilation, care should be taken to ensure sufficient 'background' air exchange occurs, such that moisture generated in the building by occupants is removed and moisture damage does not occur.	Infiltration testing to be carried out using EU Standard 13289 Building sealing activity to be based on consultant advice following building testing and benchmarking. Pro-rata infiltration reduction targets or absolute targets should be put forward in a business case for infiltration minimisation upgrades. Proposal shall include a list of actions to be carried out including basic costings and energy/GHG savings predicted from upgrade activity.	Refer to: – Building Code of Australia; – EUS 13289; – ASTM 283; – CIBSE TM29 – Heating, ventilation and air conditioning strategies for well-insulated airtight buildings Pressure testing: – CIBSE TM23: 2000 Testing buildings for air leakage; – ASTM Standard E779 (ASTM 2003) describes the fan pressurization test procedure in detail; and – ATTMA Standard: MEASURING AIR PERMEABILITY OF BUILDING ENVELOPES. – http://en.wikipedia.org/wiki/Blower_door	10+ years	AIRAH for exhaust duct valves 10+ years Likewise for building sealing elements.
BE 2 – Roof Insulation (conditioned spaces only)	Energy +	Envelope	Roof	Insulation can help minimise the conductive effects between outside and inside a building, reducing the need to cool or heat a space. The amount of heat transfer is proportional to the heat transfer coefficient of the insulation. For Melbourne's climate with hot summers and temperate winters, where many buildings require cooling year round, it is important to insulate to minimise the heat gain from outside to inside spaces.	BCA Part J 2010 minimum performance requirements. See BCA table J1.3 for buildings in climate zone 6: – minimum roof R-Value of 3.2 (C/m2/W) Refer also BCA J1.2 ref AS/NZS 4859.1 Materials for the thermal insulation of buildings.	BCA Section J 2010 AS/NZS 4859.1	10+ years	DEER 2008: EUL Summary www.deeresources.com/ deer2008exante/.../EUL_ Summary_10-1-08.xls
BE 3 – Cool roof coating	Energy +	Envelope	Roof	A cool roof is a roof with a high solar reflectance and thermal emittance. Cool roofs can decrease the building cooling load, and the urban heat island effect. A low solar reflecting roof, such as a black roof can reach temperatures of up to 70 degrees Celsius, leading to an increased building heat load. In Melbourne, which has a greater number of cooling degree days than heating degree days, the use of a cool roof to reduce air conditioning load can lead to energy savings. The cool roof can be created via a choice of roof material or, in the case of a retrofit, can be made by applying a solar reflective coating to its surface. Suppliers should be willing to provide warranty for the application of their product.	Solar Reflectance Index of 78% (also known as Total Solar Reflectance TSR) applied to at least 75% of roof over conditioned areas. Refer LEED office rating system credit 7.2 for detail.	http://www.coolroofs.org/ (USA Cool Roof Rating Council, See for specs and cool roof rebate programs) http://www.nutechpaints.com.au (see for possible relevant standards) LEED credit 7.2 gives credit to roofs 75% covered with material with Solar Reflective Index (SRI) of at least 78% http://www.coolroofs-eu.eu/ EU Cool Roofs program http://coolcolors.lbl.gov/ http://www.roofcalc.com/ Relevant standards include AS1580, AS1627, ASTM D1005	10+ years	LEED http://www.usgbc.org/ LEED/
BE 4 – Green roof installation	Energy + Water + or -	Envelope	Roof	Extensive green roofs generally include a shallow layer (20-150mm) of light weight growing medium (also referred to as 'substrate') planted with low-growing stress-tolerant species such as succulents, grasses and wildflowers. These light-weight systems require little or no maintenance, use less water and impose less weight on the building structure than intensive green roofs. Intensive green roofs have a deeper growing medium (150mm+), than extensive green roofs, where a variety of plants, vegetables, shrubs and even trees can be grown. As these types of roofs typically support a diverse range of plant species, they can provide a valuable habitat for wildlife. They require frequent maintenance, similar to that needed in a normal garden, which is why they are referred to as 'intensive'. The combination of the substrate (including the water and air held within) and the vegetation acts as thermal insulation for the roof, provided that it covers the roof plane fully. It can also provide an acoustic barrier, stormwater management benefits and roof membrane protection. As an additional benefit, if a large number of buildings in a densely populated area install green roofs, the urban heat island effect (increased temperature compared to rural areas) can be decreased due to lower re-radiation of stored energy. Both extensive and intensive green roofs are often accessible and can be used for recreational facilities and/or public spaces. They also place significant weight on the building structure. As such structural consultation is an important step for green roof retrofit. Green roof should be critically assessed for their specific environmental value. Roof plaza areas with minimal green space or a roof terraces with pot plants or planter boxes may provide some benefits, but are not generally considered true green roofs.	Mandatory requirements – 100% coverage of exposed roof area (including exposed roof areas under equipment etc.) within a distinct roof zone. – a minimum 80mm substrate depth (continuous cover required for the life of the green roof upgrade i.e 10+ years minimum) Other considerations for a successful green roof: – Weight bearing capacity of the building – Climatic conditions e.g. solar access, wind effects – Water balance (demand v availability – rain events and storage capacity) – Physical access (including maintenance access) – Use of roof e.g. recreational – Plant selection – Membrane specification and leak detection Applicants to demonstrate the design intent to reduce energy and/or water consumption of the building through a green roof installation. Structural assessment must have been completed to confirm that the roof can support a green roof.	http://www.yourhome.gov.au/technical/pubs/fs513.pdf http://www.landfood.unimelb.edu.au/green/greenroof.html http://www.greenroofsaustralia.com.au/ http://www.growingup.org.au/ http://www.melbourne.vic.gov.au/Environment/WhatCouncilisDoing/Pages/Greenroofs.aspx	10+ years – requires maintenance.	To be provided by applicant. Likely to be based on guarantees from installer or manufacturers.
BE 5 – Wall Insulation (conditioned spaces only)	Energy +	Envelope	Walls	Insulation can help minimise the conductive effects between outside and inside a building, reducing the need to cool or heat a space. The amount of heat transfer is proportional to the heat transfer coefficient of the insulation. For Melbourne's climate with hot summers and temperate winters it is important to insulate to minimise the heat gain from outside to inside spaces.	BCA Part J 2010 minimum performance requirement. See BCA table J1.3 for buildings in climate zone 6: – Minimum roof R-Value of 1.8 (C/m2/W) for class 5,6,7,8, or 9a buildings. – R-Value 1.7 for class 2, 3, 4 or 9c buildings Refer also BCA J1.2 ref AS/NZS 4859.1 Materials for the thermal insulation of buildings.	BCA Section J 2010 AS/NZS 4859.1	10+ years	DEER 2008: EUL Summary www.deeresources.com/ deer2008exante/.../EUL_ Summary_10-1-08.xls

COMMON LIST OF IMPROVEMENTS *PRE-APPROVED* FOR ENVIRONMENTAL UPGRADE CHARGES / P2

SUSTAINABLE MELBOURNE FUND

Improvement	Environmental Upgrade Benefit (+)	System	Sub-system	Description	Eligibility Requirement	Further Information	Effective Useful Life (EUL)	Source for EUL
Building Envelope CONTINUED								
BE 6 – External solar shading	Energy +	Envelope	Windows	Considering Melbourne's hot summers, external solar shading can be used to minimise solar gain into spaces during summer, whilst still allowing for some passive gain over the winter months. For north elevations, horizontal sunshades should be provided – designed to mitigate solar gains during summer and allow for some passive solar gains during winter. East and West facades are more difficult when it comes to effective all round shading outcomes. Angled vertical sunshades mitigate peak heat loads during early morning and late afternoon/evening respectively on East/West facades. Horizontal sunshades are beneficial during the later morning and early afternoon hours. External shading screens may also be considered a reasonable shading solution. Depending on orientation and design intent any of the below shading solutions can be effective: – Fixed vertical or horizontal shades; – Fixed perforated screens; – Non-uniform external shading elements obstructing a % of facade area from direct solar radiation. Consideration could be given to vegetated walls as external shading. Shading by surrounding buildings must be considered when developing external solar shading improvements to ensure energy savings are achieved.	If shades are being added as a part of a total facade upgrade, the façade system must meet BCA Part J 2010 minimum. If upgrade is only adding shades to existing facade: – For simple horizontal shades performance to show a % improvement on BCA 2010 Section J glazing calculator from base design for all orientations that shading is being applied. – For vertical shades, operable shades and shades with complex geometry a consultants report showing the year round energy benefits of the shading solution should be submitted. This should be based on thermal modelling or equivalent calculations for year round thermal performance.	CIBSE TM37 Design for improved solar shading control CIBSE LG10 Daylighting and Window Design www.abcb.gov.au/abcbonline/default.asp Should also consider glare control and daylighting. Refer to Green Star IEQ-5 Glare control credit Relevant structural code: AS/NZS1170 Structural design actions	10+ years	Manufacturer
BE 7 – High Performance Windows	Energy +	Envelope	Windows	Melbourne's has a temperate climate with warm, hot summers and mild winters. Because of this it is important to minimise solar radiation through windows by the use of high performance glazing. Of critical importance is a low solar heat gain coefficient (SHGC) on the north, east and west facades. The south facade should have a lower performance glazing to allow for passive winter cooling. Equally to minimise conduction gains U-Value is important to limit winter heating loads, and stop additional conduction gains adding to cooling loads in summer months. AS1288 Glass in buildings, selection and installation AS/NZS 4666 Insulating glass units AS/NZS 2208 Safety glazing materials in buildings (if applicable)	Façade system to meet BCA Part J 2010 minimum.	http://www.abcb.gov.au/abcbonline/default.asp	10+ years	Manufacturer
BE 8 – Window film installation	Energy +	Envelope	Windows	A solar control film is a thin layer of polyester based material that can be installed on a glass surface. It is installed on the inside of windows to reduce the amount of incoming solar radiation.	Maximum SHGC = improvement of at least 20% Minimum VLT = 30%	CIBSE LG10 Daylighting and Window Design	10	DEER 2008: EUL Summary www.deeresources.com/deer2008exante/.../EUL_Summary_10-1-08.xls
Heating, Ventilation & Air Conditioning (HVAC)								
HVAC 1 – Economizer (Air and/or Water-side)	Energy +	HVAC	AHUs	Melbourne's climate often provides comfortable ambient conditions. As an energy saving measure air and/or water-side economiser systems can be implemented to make use of 'free' conditioning that ambient conditions provide. An air-side economiser will ensure that full fresh air is brought into the building through HVAC systems when outdoor temperature conditions are suitable. As such there is no recirculated air when controls switch to economiser mode. Building energy savings result from avoiding the use of mechanical cooling equipment. A water side economiser is a control measure that can be implemented on top of air-side economy cycle. When conditions are suitable full fresh air is brought directly into the building without any conditioning. As such HVAC plant is not required to do any work during these hours. Note that older Building Management Systems (BMS) may require upgrade to be able to implement these control measures.	Must not just be a control measure. Must include the installation of new equipment associated with implementation of an economy cycle to be eligible.	AIRAH Technical Handbook ASHRAE Application Guide CIBSE Guide B – HVAC Systems CIBSE Commissioning Code A – Air Distribution Systems CIBSE Soft Landings Framework CIBSE KS12 Refurbishment for energy efficiency CIBSE Guide H Building Control Systems	10+ years	AIRAH Technical Handbook
HVAC 2 – Burner upgrade +	Energy +	HVAC	Boilers	The burner within a boiler mixes air and fuel together. An efficient burner will maximise combustion efficiency whilst minimising the release of emissions. For 'mid life' boilers that have not yet reached the end of their useful economic life, a burner upgrade can result in improvements in combustion efficiency and a decrease in NOx emissions. Older burners often have mechanical linkages and drive motors for fuel and air mixing that are worn out. Because of this, they are adjusted to provide high levels of excess air to compensate, and are hence running at a lower efficiency than is possible.	Commitment to implement improvement.	AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency CIBSE Guide H Building Control Systems	10+ years	ASHRAE – HVAC Applications 36.3 Table 4: Burners

COMMON LIST OF IMPROVEMENTS *PRE-APPROVED* FOR ENVIRONMENTAL UPGRADE CHARGES / P3

SUSTAINABLE MELBOURNE FUND

Improvement	Environmental Upgrade Benefit (+)	System	Sub-system	Description	Eligibility Requirement	Further Information	Effective Useful Life (EUL)	Source for EUL
Heating, Ventilation & Air Conditioning (HVAC) CONTINUED								
HVAC 3 – Combustion fan VSD	Energy +	HVAC	Boilers	With older boilers the fans are set at a constant speed regardless of the heating load required by the system, with modulation by dampers. Therefore whilst the heating demand may only be 30% of the full load, the electrical load may be much higher. With a variable speed drive (VSD), the fans are slowed down to match the lower airflow rates required. This can significantly decrease the electrical load from the fan, as electrical power consumption is proportional to the cube of the motor speed (i.e. half the speed reduces the power consumption to around an eighth). Variable Speed Drive (VSD) upgrades are particularly attractive when the boiler load profile is variable. Because they operate at lower speeds, incorporating a VSD can also reduce noise levels, and can reduce maintenance cost, as wear on moving parts is reduced.	Commitment to implement improvement.	AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency	10+ years	AIRAH Technical Handbook
HVAC 4 – Install boiler economizer	Energy +	HVAC	Boilers	A boiler economiser is essentially a heat exchanger which uses heat from boiler exhaust gases to pre-heat feed in water before it enters the boiler. Heat contained in these exhaust gas is otherwise lost to the atmosphere. Boiler economisers are particularly common in industrial applications using large steam boilers, however the measure can also be effective in building heating and especially domestic hot water applications. This process is similar to what already happens in new 'condensing boilers' which have an internal heat exchanger performing the same function of extracting additional heat from flu gases.	Commitment to implement improvement.	AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency	10+ years	AIRAH Technical Handbook
HVAC 5 – Boiler replacement. Efficient unit replacement	Energy +	HVAC	Boilers	Water heaters are used to produce heating hot water, which is then reticulated to coils within air handling units, or other devices, to heat air. Water heaters are generally gas fired, but may also be fitted with oil burners. There are two main types of boilers – fire tube and water tube. In a water tube boiler, the water circulates through the tubes, with the burner underneath. A fire tube boiler has a watertight outer jacket with tubes through the centre of it. The flame is directed within the tubes. Replacing old units with new poses significant efficiency gain opportunities, especially with regard to part load performance. Condensing boilers should be considered. They include an additional heat exchanger which utilises hot flu gases to provide pre-heat of incoming heating hot water. In this way energy which would otherwise be wasted is now utilised. Condensing boilers are more efficient for this reason and should be considered for boiler upgrade activity	Boiler to meet minimum BCA Part J 2010 requirements	AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency CIBSE Guide H Building Control Systems	10+ years	AIRAH Technical Handbook
HVAC 6 – Oxygen trim controls	Energy +	HVAC	Boilers	Oxygen trim is a control process to provide optimal conditions for combustion in a boiler. Air flow into the combustion chamber is regulated to provide the correct air/fuel mix based on operating point of the equipment. Note that commissioning of these systems is imperative for the improvement measure to have a positive impact.	Commitment to implement improvement.	AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency	10+ years	AIRAH Technical Handbook
HVAC 7 – Chiller replacement. Efficient Unit Replacement	Energy +	HVAC	Chillers	Chillers produce cooled water for use in air conditioning systems. Chilled water is typically distributed to coils within air handling units, or other devices, to cool air, which is then distributed to the space where cooling is desired. Chillers can range from small reciprocating compressor units, through to large units with screw, scroll or centrifugal compressors. The efficiency of a chiller is normally quoted as a Coefficient of Performance (COP) for full load which is the ratio of useful cooling (kWr) to electrical input (kWe), or an Integrated Part Load Value (IPLV) for part load. Modern chillers have significant COP increases on previous generations of chillers, and hence a chiller replacement can reduce energy usage significantly. The following should be considered in the selection of chillers: – Performance characteristics at part and full load; – Minimum turndown required; – Chilled water temperature and differential; and – Compressor selection. There are two main methods of chilled heat rejection, with varying COPs. Air cooled chillers reject heat to the ambient with an air-cooled condensing coil. Water cooled chillers use water as the condensing medium and use a pump to circulate water through the condenser and out to a cooling tower that rejects heat to the atmosphere. Air cooled chillers have a lower COP than a comparative water cooled chiller (even when the power of the cooling tower fans and condenser water pumps are included), however air cooled chillers eliminate the need for concerns and maintenance requirements of cooling towers and condenser water treatment.	Must comply with: – BCA Section J; and – ASHRAE 90.1 recommended values for COP and IPLV (Table 6.8.1C) Must be based on data supplied from certified ARI testing.	AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency CIBSE Guide H Building Control Systems	10+years	AIRAH Technical Handbook

COMMON LIST OF IMPROVEMENTS *PRE-APPROVED* FOR ENVIRONMENTAL UPGRADE CHARGES / P4

SUSTAINABLE MELBOURNE FUND

Improvement	Environmental Upgrade Benefit (+)	System	Sub-system	Description	Eligibility Requirement	Further Information	Effective Useful Life (EUL)	Source for EUL
Heating, Ventilation & Air Conditioning (HVAC) CONTINUED								
HVAC 8 – Heat recovery	Energy +	HVAC	Chillers	Chillers reject heat into a condenser. Water cooled chillers do this via a condenser water loop which is linked to cooling towers. In this situation heat recovery can be used to provide a pre-heat to the heating hot water loop which alleviates a portion of the load which boilers have to meet.	Commitment to implement improvement.	AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency CIBSE Guide H Building Control Systems	10+years	AIRAH Technical Handbook
HVAC 9 – Installing VSD & controls for fans	Energy +	HVAC	Cooling Tower	A forced draught cooling tower has a fan mounted on its side, in the path of ambient air, whilst an induced-draught cooling tower has the fan mounted on the top in the path of the exiting air. Both design use the fans to provide the flow required to extract heat from the condenser water. A Variable Speed Drive (VSD) can be used to modulate the speed of these fans to match the ambient conditions. This is appropriate for Melbourne weather conditions which can range from hot and dry to cold and humid.	Commitment to implement improvement.	AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency CIBSE Guide H Building Control Systems CIBSE Commissioning Code A – Air Distribution Systems	10+years	AIRAH Technical Handbook
HVAC 10 – Replacement or additional capacity	Energy +	HVAC	Cooling Tower	The fans used to drive cooling tower motors can consume a large amount of energy over the year. Newer model cooling towers can incorporate such features as VSD drives and high performance and direct drive motors. Additionally larger cooling tower can be replaced with a series of smaller modular models to allow for individual towers to be shut off when they are not required. Cooling tower replacement or upgrade should be considered in conjunction with controls measures such as condenser water reset strategies.	Cooling tower to meet: – BCA Part J clause J5.4f; and – ASHRAE 90.1 suggested fan power vs. cooling capacity; and – Must be variable flow fan control	AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency CIBSE Guide H Building Control Systems CIBSE Commissioning Code A – Air Distribution Systems	10+years	AIRAH Technical Handbook
HVAC 11 – Upgrades to reduce bleed off and drift	Water +	HVAC	Cooling Towers / Evaporative condensers	Cooling towers work by spraying condenser water over the fill material, over which air is then passed. The resulting evaporative effect removes the heat from the condenser water. The cooled water that collects in the basin then returns to the chiller or compressor to complete the cycle. Typically 0.1% of the cooling tower water is evaporated. There are other losses that can occur in a cooling tower, which can be minimised through good technology and maintenance: – Bleed: To reduce the build up of dissolved and suspended solids, some of the condenser water is bleed from the circuit. The amount bleed is determined by the conductivity in the water. The water loss from bleed is automatically controlled by conductivity sensors. When the conductivity is higher than a set-point, a valve will open and bleed of some of the water. Due to the good quality of Melbourne water, it could be possible to increase the cycles of concentration (ratio of concentration of dissolved solids in the condenser water to that of the make up water) to 8 (or higher), reducing the bleed going to sewer. – Drift: Drift is the water lost from the cooling tower as liquid droplets are entrained in the exhaust air. Correct placement of the drift eliminator can help minimise the amount of water and chemical lost to the atmosphere as drift.	Must perform to; – Minimum of 6 cycles of concentration; and – Drift rate of not more than 0.002% water loss	AS3666 http://www.sydneywater.com.au/Publications/_download.cfm?DownloadFile=FactSheets/SavingWaterCoolingTowers.pdf http://www.sydneywater.com.au/Publications/_download.cfm?DownloadFile=FactSheets/SavingWaterBestPracticeGuidelinesCoolingTowers.pdf	10+ years	Manufacturer
HVAC 12 – Hot/Cold Aisle Containment	Energy +	HVAC	Data Centre	Traditionally data centres have been cooled via perimeter based Computer Room Air-Conditioning (CRAC) units, with cold air delivered by an underfloor plenum. The hot exhaust air mixes with the cold air, and is delivered back to the CRAC unit. Modern data centres can manage airflow significantly better leading to significant energy performance gains. There are two main types of containment systems: – Cold aisle containment, where the air is supplied directly to a (sealed) cold aisle(s), with the rest of the data centre room space then acting as the hot air return plenum. – Hot aisle containment, where the hot server exhaust air is captured and cooled directly for the rack. This requires a close coupled cooling system such as in-row coolers. The efficiency is greatest for a hot aisle system because of the higher temperatures the hot aisle can run at, compared to a normal (unenclosed) data centre.	Initial design report from consultant displaying HVAC strategy and demonstrating indicative energy savings. Hot and cold aisle containment installed	Seek specialist advice	10+years	Manufacturer
HVAC 13 – Cooling tower fan sequencing	Energy +	HVAC	Energy Management Controls	Effective cooling tower fan control is essential, especially when multiple towers are installed. Optimising the control strategy to maintain condenser water system can lead to good energy savings. For example, every tower system will vary the amount of air flowing across the heat transfer elements as part of the control strategy. Commissioning the system and making sure the particular control strategy employed (fan cycling, 2-speed motor, or VSD) is optimized will reduce system energy usage.	Can only be implemented in combination with cooling tower equipment replacement or upgrade.	AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency CIBSE Guide H Building Control Systems	10+ years	AIRAH Technical Handbook

COMMON LIST OF IMPROVEMENTS *PRE-APPROVED* FOR ENVIRONMENTAL UPGRADE CHARGES / P5

SUSTAINABLE MELBOURNE FUND

Improvement	Environmental Upgrade Benefit (+)	System	Sub-system	Description	Eligibility Requirement	Further Information	Effective Useful Life (EUL)	Source for EUL
Heating, Ventilation & Air Conditioning (HVAC) CONTINUED								
HVAC 14 – Retro-commissioning	Energy +	HVAC	Energy Management Controls	Commissioning of mechanical equipment is imperative to efficient and effective building HVAC performance. In existing buildings, retro-commissioning of equipment alone can reduce energy consumption by up to 10%-20%. Stand alone retro-commission activity is commonplace in the energy performance contracting market due to it financial returns. For this reason commissioning of HVAC systems is only included in SMF when combined with building HVAC upgrade activity. Ensuring proper commissioning of building is recognised in Green Star rating schemes. There are a number of standards and methodology which have been developed by building professionals in association with industry bodies such as CIBSE, BSRIA and ASHRAE.	Can only be used in combination with other HVAC items that involve the installation of new equipment. Commissioning of new equipment, and associated/affected systems is mandatory for the introduction of any new equipment installed under an Environmental Upgrade Agreement.	BSRIA AG3 – Commissioning Air Systems CIBSE Guide B – HVAC systems CIBSE Guide F – Energy efficiency in buildings CIBSE Guide M – Maintenance engineering and management CIBSE KS5 – Making Buildings Work CIBSE KS9 – Commissioning variable flow pipework CIBSE KS12 – Refurbishment for energy efficiency CIBSE soft-landings-framework	10+ years	AIRAH Technical Handbook
HVAC 15 – Installing VFD & controls	Energy +	HVAC	Fans	Fan energy is one of the major components of base building energy use. Many fans, especially in older buildings are set up to operate on a duty cycle. This means that they will run at design capacity whenever they are on. Significant advances in fan control technology allow building owners with the option to install variable flow units with a number of different control options. Many units in the market now are designed specifically for the building retrofit market. These VSD fans are generally plug in units that take on/off command from an existing (old) building management or automation system (BMS/BAS), but will also contain close loop control for fan operating point and flow modulation. Units may also be fully integrated with BMS but this can sometimes prove troublesome with older BMS units. Significant energy savings can be made by better controlling fan operation with attractive payback periods.	Commitment to implement improvement.	CIBSE TM42 Fan Application Guide AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency CIBSE Guide H Building Control Systems	10+ years	AIRAH Technical Handbook
HVAC 16 – Motor Replacement	Energy +	HVAC	Fans and Pumps	Fans and pumps are generally driven by electric motors. Larger units are typically powered by 3-phase AC motors which can be highly efficient. Older AC motors especially single phase motors are far less efficient than modern motors. A simple motor replacement can lead to respectable energy savings. Note that the impact of this measure is significantly enhanced when combined with variable speed control measures.	BCA 2010 Section J Where appropriate should be combined with variable speed control.	CIBSE TM42 Fan Application Guide AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency CIBSE Guide H Building Control Systems	10+ years	AIRAH Technical Handbook
HVAC 17 – Solar thermal space heating (hydronic)	Energy +	HVAC	Heating	Apart from its use in domestic hot water, the hot water produced from solar thermal heating can be distributed through radiators to produce winter heating. Retrofit of this sort of heating system may be – depending on building – far more involved than simple installation of a solar thermal collector array. Thought needs to be given to what purpose heat collected in summer months will be put to. Summer month heat demand is generally what drives/limits the size of these systems and can be somewhat restrictive in Australia.	Solar hot water system to be compliant with: – Federal government RECs scheme (if applicable with regard to system size & application); or – Victorian state government solar hot water for industry, Solar Hot Water rebate program (if applicable with regard to system size & application).	http://www.energymatters.com.au/renewable-energy/solar-power/hydronics/solar-thermal-home.php See the below link for a list of commercially available systems with a minimum efficiency of 60% as per AS4234-1994. http://www.sustainability.vic.gov.au/www/html/2022-solar-hot-water-for-industry.asp http://www.orer.gov.au/swh/register.html CIBSE KS15 Capturing Solar Energy	10+ years	Manufacturer
HVAC 18 – Duct and pipework Insulation	Energy +	HVAC	HVAC System (General)	Duct and pipework carry air and water around the building to provide heating and cooling. Insulation protects these working fluids from contact with external ambient conditions in particular which is a system energy loss. Installing the right amount and type of insulation can significantly reduce loss of energy in the heating and cooling systems resulting in a more efficient HVAC system overall.	BCA 2010 Section J	BCA 2010 Section J AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency	10+years	AIRAH Technical Handbook
HVAC 19 – Use heating hot water for zone reheat	Energy +	HVAC	HVAC System (General)	Many installations use electric heating coils for zone reheat. Due to the energy intensive nature of electricity production in Victoria (the carbon emissions for electricity generation are approximately 6 times the carbon emissions for gas generation), switching from an electric re-heat system to a hot water re-heat system linked up to gas fired boiler can significantly cut carbon emissions.	Any equipment installed should be designed to the following minimum requirements (as per AIRAH Technical Manual). Water side systems: – Hot Water Pipe – Max flow velocity of 2.4m/s – Heating Coil – Max flow velocity of 1.5m/s Air side systems: – Heating Coils – Max air face velocity of 3.5m/s	BCA 2010 Section J AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE Commissioning Code A – Air Distribution Systems	10+ years	AIRAH Technical Handbook
HVAC 20 – Variable Air Volume (VAV) fume hoods	Energy +	HVAC	Laboratories	One of the main energy uses within a laboratory is with fume hoods. A fume hood is used to limit exposure to dangerous chemicals in a laboratory. Air is typically drawn from the front of the cabinet and then exhausted to outside, Traditional fume hoods are a constant volume system, regardless of sash position. Newer models adjust the extract rate as the sash opens or closes to maintain a constant face velocity across the hood (minimum of 0.5 m/s).	Commitment to implement improvement.	www.labs21.lbl.gov BCA 2010	10+years	www.labs21.lbl.gov
HVAC 21 – Efficient Unit Replacement	Energy +	HVAC	Pumps	Older pumps may be less inefficient than newer models, as well as not being sized correctly to meet the load. Installing new efficient units with efficient motors and efficient impeller design means that energy usage can be decreased. A more efficient pump only takes advantage of a portion of available energy savings. Pumps fitted with variable speed control will have the ability to modulate operation with building demand thus saving energy. This should be considered on all pump replacement improvement projects.	For capacity less than 10l/s: – Min 60% efficient at design flow/pressure – VSD control is highly recommended For capacity greater than 10l/s: – Min 70% efficient at design flow/pressure – Must be fitted with VSD control	AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency CIBSE Guide H Building Control Systems CIBSE KS7 – Variable flow pipework systems	10+ years	ASHRAE – HVAC Applications 36.3 Table 4: Burners

SUSTAINABLE MELBOURNE FUND

Improvement	Environmental Upgrade Benefit (+)	System	Sub-system	Description	Eligibility Requirement	Further Information	Effective Useful Life (EUL)	Source for EUL
Heating, Ventilation & Air Conditioning (HVAC) CONTINUED								
HVAC 22 – Installing VFD & controls	Energy +	HVAC	Pumps	Many pumps are sized for a maximum load, that may only be met for a small percentage of the year. A variable frequency drive (VFD) adjusts the speed on the electronic motor to match demand. A pump running at a lower frequency consumes less energy. Due to the variable nature of Melbourne's climate, a pump is likely to only be running at full speed for a small amount of the year, and hence the installation of a VSD can produce significant energy savings.	Must show that equipment has been installed and that this is linked in with a variable flow control system, either BMS linked or closed loop.	BSRIA AG14 – Variable Speed Pumping in Heating and Cooling BSRIA AG16 – Variable Flow Water Systems CIBSE KS7 – Variable Flow Pipework Systems CIBSE KS9 – Commissioning variable flow pipework CIBSE KS12 – Refurbishment for energy efficiency	10+ years	AIRAH Technical Handbook
HVAC 23 – Installing VFD & controls	Energy +	HVAC	Pumps	Pump energy makes up a major component of base building energy use. Older pumps generally operate on duty on/off control. This means that they will run at design capacity whenever they are on. VFD pumping system can operate on closed circuit constant pressure variable flow operation. More complex BMS linked control schemes can also be implemented to optimise loop temperatures etc. Installation of variable speed control for a pumping loop will also include the installation of 2-port valves, sensing and control equipment. Commissioning will be important to the successful implementation of a variable speed pumping setup.	Commitment to implement improvement.	AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency CIBSE Guide H Building Control Systems CIBSE KS7 – Variable flow pipework systems	10+ years	AIRAH Technical Handbook
HVAC 24 – Trimmed impeller / impeller replacement	Energy +	HVAC	Pumps	Impeller trimming is the process of decreasing the diameter of an impeller by machining to decrease the energy added to the system fluid. Impeller trimming provides a useful correction to pumps that are oversized for their application, and may be a more economical option then an impeller replacement.	For capacity less than 10l/s: – Min 60% efficient at design flow/pressure For capacity greater than 10l/s: – Min 70% efficient at design flow/pressure	http://www1.eere.energy.gov/industry/bestpractices/trim_replace_impellers8.pdf	10+ years	AIRAH Technical Handbook
HVAC 25 – Efficient Unit Replacement	Energy +	HVAC	Split Systems/ Heat Pumps	Split systems and heat pumps consists of two main components – an indoor and an outdoor unit. They take advantage of the vapour-compression cycle to provide cooling or heating to a space. A split system is able to provide cooling, by transferring the heat to the outdoor unit. In a heat-pump the process is reversed, such that heat is produced. Because this is a heat transfer mechanism as opposed to an energy conversion, it is an efficient way to provide heating and cooling. The efficiency of split systems and heat pumps have increased dramatically over the last 20 years. Replacing an older unit with a more modern, high-efficient unit, can result in high energy savings.	BCA Part J/MEPs minimum requirements. Recommended industry best practice for Packaged A/C systems is full load: – COP of 3.0 for air cooled systems (Capacity <10kW); – COP of 3.3 for Systems (10kW<Capacity<50kW); and – COP of 5.0 for Packaged systems (50kW>Capacity>100kW).	BCA Section J ASHRAE 90.1 AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency	10+ years	AIRAH Technical Handbook
HVAC 26 – Upgrades to reduce bleed off	Energy + Water +	HVAC	Steam Boilers	Steam boilers require periodic bleed off to prevent over-concentration of dissolved solids. Often a timer based blow-down system is used, to ensure frequent small blowdown. With a fluctuating load this may lead to bleed off occurring too often, or not enough. An automatic control system can provide closer control of boiler bleed off by monitoring Total Dissolved Solid (TDS) levels in the system, thus decreasing the amount of make-up water required (and also decreasing the energy used).	Commitment to implement improvement.	AIRAH (Australian Institute of Refrigeration, Air-Conditioning and Heating) holds a register of accredited water treatment companies — see http://www.airah.org.au/spe_wat_man.asp for more information.	10+ years	AIRAH Technical Handbook
HVAC 27 – Car park ventilation CO controls	Energy +	HVAC	Ventilation	Carbon Monoxide (CO) controlled ventilation of car park areas is an effective way of reducing car park fan energy while maintaining acceptable levels of carbon monoxide and other pollutants. CO control ventilation is tightly regulated by AS1668.2 to maintain occupant health and safety. In this way fans cycle off if no pollution is being created in the space and CO levels are at acceptable levels. As pollution from vehicles begins to fill the space fans ramp up to exhaust fumes and bring in outdoor air. Significant energy savings are available with attractive payback periods.	Compliance with AS1668.2	AS1668.2 AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment CIBSE Guide B – HVAC Systems CIBSE KS12 Refurbishment for energy efficiency CIBSE Guide H Building Control Systems	10+ years	AIRAH Technical Handbook
Domestic Hot Water (DHW)								
DHW 1 – Insulation/ lagging	Energy +	Hot Water, Domestic (DHW)	Water Heater	Heating water can be a significant energy use in buildings. With inadequate insulation, heat loss to the surrounding environment can add to energy usage, especially over the colder Melbourne months.	To comply with BCA Specification J5 Table 2 pipe insulation. R-Value will vary (0.6-0.8) depending on location.	www.pic.vic.gov.au/resources/documents/Thermal_insulation_of_heated_water_pipework.pdf	10+ years	DEER 2008: EUL Summary www.deeresources.com/deer2008exante/.../EUL_Summary_10-1-08.xls
DHW 2 – Efficient Unit Replacement	Energy +	Hot Water, Domestic (DHW)	Water Heater	A domestic hot water heater heats water for use for relatively small or isolated uses, such as kitchens and bathrooms. Typically within Melbourne heating will be done via natural gas, although electric heaters are not uncommon. Due to the higher carbon content of producing electricity in Melbourne, electric heaters have a higher associated carbon footprint. As an alternative, a heat pump water heater removes heat energy from the air and stores it within the water tank. Because this is a transfer of heat and not a conversion of energy these have a COP of 2.5-4, and thus are comparable in carbon output to a gas heater. If the evaporator of the heat pump can be placed in the path of an air condition outlet duct, performance will be increased further.	Minimum 5 star energy rating Note that: – This improvement applies to small hot water heaters which may be installed in kitchens or small stand alone DHW units. – This improvement does not apply to larger boilers or gas fired space heaters.	www.resourcesmart.vic.gov.au/documents/SRI_gas_water_heaters.pdf http://www.climatechange.gov.au/what-you-need-to-know/appliances-and-equipment/hot-water-systems/gas.aspx	10+ years	AIRAH Technical Handbook

SUSTAINABLE MELBOURNE FUND

Improvement	Environmental Upgrade Benefit (+)	System	Sub-system	Description	Eligibility Requirement	Further Information	Effective Useful Life (EUL)	Source for EUL
Domestic Hot Water (DHW) CONTINUED								
DHW 3 – Solar thermal hot water system	Energy +	Hot Water, Domestic (DHW)	Water Heater	Solar thermal heating is a carbon free way to produce domestic hot water. There are two main types of solar water heaters, evacuated tubes and flat plater collectors. Evacuated tubes are generally preferred as they capture more sunlight, have better heat transfer characteristics, and require smaller roof area than an equivalent flat panel system. With Melbourne's climate it is likely that some form of boosting (gas) will be required to supplement the solar panels on cloudy days.	Solar hot water system to be compliant with: – Federal government RECs scheme (if applicable with regard to system size & application); or – Victorian state government solar hot water for industry, Solar Hot Water rebate program (if applicable with regard to system size & application).	In line with Victorian government solar hot water funding for industry scheme, suggest minimum peak efficiency of 60% under AS4234-1994 testing. See below link for listings of such units available in Victoria. http://www.sustainability.vic.gov.au/www/html/2022-solar-hot-water-for-industry.asp http://www.orer.gov.au/swh/register.html CIBSE KS15 Capturing Solar Energy	10+ years	Manufacturer
Pool								
P 1 – Add pool cover	Water + Energy +	Pool	Pool	Up to 70% of a pool's heat loss is through evaporation. The use of pool covers can also reduce the amount of water lost to evaporation, reducing the volume of make-up water required by up to 30%. For the Melbourne climate, which is a warmer climate, the pool cover should be reflective, to reduce the amount of light reflected by the pool.	Pool covers to be designed to cover entire pool. Provide information to show that pool cover operation is to be included in building's current O&M manual and schedule. To be eligible it must be demonstrated that measures are in place to ensure the installed covers are used.	US Department of Energy, Energy Efficiency & Renewable Energy, Energy Savers, Swimming Pool Covers (http://www.energysavers.gov/your_home/water_heating/index.cfm/mytopic=13140)	10+ years	Manufacturer
P 2 – Efficient Heater Replacement	Energy +	Pool	Pool	See Boiler Replacement	See Boiler Replacement	http://www.sydneywater.com.au/Publications/_download.cfm?DownloadFile=Factsheets/SwimmingPools.pdf	10+ years	AIRAH Technical Handbook
P 3 – Replace Motor	Energy +	Pool	Pool Pump	See Pump/Fan Motor Replacement	See Pump/Fan Motor Replacement	See Pump/Fan Motor Replacement	10+ years	AIRAH Technical Handbook
P 4 – Replace Pump	Energy +	Pool	Pool Pump	See Pump Replacement	See Pump Replacement	See Pump Replacement	10+ years	AIRAH Technical Handbook
Electrical								
E 1 – Programmable lighting control system	Energy +	Lighting	Controls	A programmable lighting control system is a device that can control the lighting system automatically based on a number of parameters, typically: scheduling, daylighting and occupancy. A fully addressable lighting system means each individual luminaire has a specific 'address', which allows it to be controlled independent of the others.	Programmable lighting control system to be carried out in combination with one of the following control strategies listed: – Occupancy sensors; – Lighting scheduling control; – Daylight control. See requirements for each of these systems individually.	See further information cells for items: – Lighting scheduling controls; – Occupancy sensor control; – Daylighting control.	10+ years	IESANZ Handbook – Reference and Application
E 2 – Daylighting controls	Energy +	Lighting	Controls	A daylight control system for lighting can adjust the level of electric lighting when natural lighting is available. A photo sensor is placed at appropriate location(s) and used to measure the prevailing natural light levels. This is particularly effective when the lighting system is a dimmable system, although excellent energy savings can be made when the lighting system is an on/off system only.	As per Green Star Office v3, Ene-4 credit Lighting Zoning: – All individual or enclosed spaces individually switched; – Size of control zones does not exceed 100m2 for 95% of retrofitted space. Only eligible if improvement is done in combination with one of (or on a system that already includes): – Occupancy sensing control; or – Lighting scheduling control.	Suggest this element should be considered in combination with façade and natural daylighting measures. CIBSE LG10 Daylighting and Window Design BRE IP 3/98 Daylighting in atrium buildings AS/NZS 1680	10+ years	IESANZ Handbook – Reference and Application
E 3 – Lighting scheduling controls	Energy +	Lighting	Controls	Unnecessary energy is used when lighting is left on in spaces that are not occupied, such as corridors, or in office spaces overnight. A lighting schedule control system can be installed to simply turn off (or dim) lighting systems according to an established schedule. These can be coupled with a manual over-ride switch in the case that spaces are occupied outside the expected timeframe.	As per Green Star Office v3, Ene-4 credit Lighting Zoning: – All individual or enclosed spaces individually switched; – Size of control zones does not exceed 100m2 for 95% of retrofitted space.	Green Star v3 – Ene-4 Lighting Zoning AS/NZS 1680 http://www.climatechange.gov.au/en/what-you-need-to-know/lighting.aspx IESANZ ABGR Tenant Management Handbook	10+ years	IESANZ Handbook – Reference and Application
E 4 – Occupancy sensing control	Energy +	Lighting	Controls	Occupancy sensors control the on/off function of a light via the use of a passive infrared sensor (PIR). The sensor is located in a position such that it responds to movement only within the occupied zone it is serving. Typically the sensor will be set detect no motion for a period of time before it will switch lights off. Occupancy control is particularly effective at reducing energy in spaces that are infrequently occupied such as toilets, changing rooms and meeting rooms.	As per Green Star Office v3, Ene-4 credit Lighting Zoning: – All individual or enclosed spaces individually switched; – Size of control zones does not exceed 100m2 for 95% of retrofitted space.	Green Star v3 – Ene-4 Lighting Zoning AS/NZS 1680 http://www.climatechange.gov.au/en/what-you-need-to-know/lighting.aspx IESANZ ABGR Tenant Management Handbook	10+ years	IESANZ Handbook – Reference and Application
E 5 – Replace existing with LED exit lighting	Energy +	Lighting	Exit Signs	Emergency lighting luminaries are designed to provide enough light for egress in emergency situations. Older exit signs may have inefficient incandescent bulbs for illumination. As these lights will often run all the time, this is a significant waste of energy. LED exit lights work by combining a large number of light emitting diodes to illuminate the sign from inside. The annual energy usage from LED lights, as compared to incandescent exit lights, can be up to 85% lower. In addition the LED lights have a much longer lifespan, and are usually brighter and have greater contrast with the background than traditional exit signs.	Commitment to implement improvement.	http://www.energystar.gov/ia/business/small_business/led_exitsigns_techsheet.pdf AS/NZS1680	10+ years	Energy Star

COMMON LIST OF IMPROVEMENTS *PRE-APPROVED* FOR ENVIRONMENTAL UPGRADE CHARGES / P8

SUSTAINABLE MELBOURNE FUND

Improvement	Environmental Upgrade Benefit (+)	System	Sub-system	Description	Eligibility Requirement	Further Information	Effective Useful Life (EUL)	Source for EUL
Electrical CONTINUED								
E 6 – Efficiency Improvement	Energy +	Lighting	Lighting upgrade	A fluorescent light is one that uses gas-discharge lamp to excite mercury vapour. These are extremely efficient lights, especially when compared to incandescent lighting. Energy efficiency can be improved further through the use of high-frequency ballasts. High frequency ballasts convert the 50Hz supply frequency into an extremely high frequency (over 30,000 Hz), which reduces ballast loss (for a standard 36W lamp) from approximately 9W to 4W. Luminaire technology has progressed significantly in recent years. Modern, high efficiency luminaires can more effectively be tailored to direct or disperse light based on space and application. Luminaire upgrade / new lighting design and layout can significantly reduce lighting power density and as such provide energy savings. High intensity discharge lamps produce light by means of an electrical arc discharge contained in an arc tube inside the bulb. The arc tube contains tungsten electrodes that terminate the arc discharge at each end of the arc tube. Variants include mercury lamps, metal halide lamps and high pressure sodium lamps. Funding for lighting systems including controls, luminaire, ballasts, lamps, electrical and design services. Note: Does not cover simple globe/ballast replacement on their own.	Lighting lumen levels: – For office space refer to Green Star IEQ-7 max 400 lux for 95% of NLA. And for all applications (including office) refer to lumen level for activity as per AS/NZS 1680 standards. Lighting power density: – For all applications lighting power density to be less than 2.5W/m2 per 100 lux luminance – as per Green Star Credit Ene-3 – for upgrade area. Where fluorescent lighting is employed, high frequency fluorescent ballasts are to be installed – as per Green Star Credit IEQ-6 for Office Design or equivalent Green Star tool.	Green Star v3: – IEQ-6 High Frequency Ballasts (32kHz+) – IEQ-7 Electrical Lighting Levels (Office space no more than 400lux artificial lighting) – Ene-3 Lighting Power Density (min 2.5W/m2/100lux ?) – Ene-4 Lighting Zoning AS/NZS 1680 series standards http://www.climatechange.gov.au/en/what-you-need-to-know/lighting.aspx IESANZ	Lumaire / reflector life 10+years. Ballast / lamp life approx 20,000 hours ` 4 – 7 years depending on operation.	The IESNA Lighting Handbook – Reference and Application
Renewable Energy								
RE 1 – Grid Tied PV System	Energy +	Renewable Energy	PV	A PV system generates electricity from solar radiation. A solar cell produces DC electricity, which passes through an inverter to convert it to AC. There are three main types of PV cell: – Mono crystalline, which are the smallest and most efficient commercially available panel – Polycrystalline, which are cheaper than mono crystalline but less efficient – Thin film, which are the least efficient. Thin film solar panels are most effective where conditions are hot and space is not at a premium, and are not recommended for Melbourne. Mono crystalline and polycrystalline are both suitable for the Melbourne climate. Note that PV installations (especially larger ones) do impose a structural load on the existing building. As such, especially in larger applications, structural assessments should be made.	Installation must occur in combination with mix of other common or custom improvements that result in reduced energy consumption for the building and be: – Installed by Clean Energy Council approved installer. – attract credits under the government solar credits/RECs program.	http://www.climatechange.gov.au/en/what-you-need-to-know/renewable-energy.aspx http://www.climatechange.gov.au/government/initiatives/renewable-target/fs-solar-credits-small-scale.aspx http://www.solaraccreditation.com.au/acccec/home.html	10+ years	IEA-PVPS
Hydraulic System								
HS 1 – Rainwater harvesting system	Water + Energy – (at site level)	Hydraulic system	Water supply	Rain water harvesting is used to capture runoff from roofs for re-use within buildings. Rainwater harvesting is most effective in buildings with large collection areas. Pre-filtration and fine-filtration can be used to remove many of the pathogens that may be in the rainwater.	Commitment to implement improvement.	www.irrigation.org.au	10+ years	Manufacturer
HS 2 – Blackwater treatment system	Water + Energy -	Hydraulic system	Water supply	Blackwater recycling involves the use of wastewater from bathrooms and kitchens. Treated blackwater is suitable for re-use applications including toilet and urinal flushing, wash down, landscape irrigation, industrial use and cooling tower make-up water.	Commitment to implement improvement.	http://www.melbourne.vic.gov.au/Environment/CH2/aboutch2/Pages/WaterConservation.aspx www.sydneywater.com.au/html/yourhome/publications/coolingtowers.pdf AS/NZS 3666 – Air Handling and Water Systems of Buildings – Microbial Control	10+ years	Manufacturer
HS 3 – Greywater system	Water + Energy – (at site level)	Hydraulic system	Water supply	Greywater recycling is the use of waste water from baths, bathroom sinks (not kitchen), and showers, which is treated before being re-used in toilet and urinal flushing, or in landscaping.	Commitment to implement improvement.	http://www.melbourne.vic.gov.au/Environment/CH2/aboutch2/Pages/WaterConservation.aspx www.sydneywater.com.au/html/yourhome/publications/coolingtowers.pdf AS/NZS 3666 – Air Handling and Water Systems of Buildings – Microbial Control	10+ years	Manufacturer
HS 4 – Showers Efficient unit replacement	Water +	Hydraulic system	Showers	Low flow shower heads can significantly reduce water consumption. Older shower heads have flow rates as high as 15L/min. Switching to low flow heads can halve the water usage used in showers	Shower heads must be rated at less than 6.0 L/min usage.	www.wels.gov.au www.allianceforwaterefficiency.org http://www.melbournewater.com.au/content/water_conservation/water_conservation.asp Water use and sustainable commercial buildings (http://www.yourbuilding.org/Article/NewsDetail.aspx?p=83&id=1584)	10+ years	Watersmart Guidebook (EBMUD 2008)

SUSTAINABLE MELBOURNE FUND

Improvement	Environmental Upgrade Benefit (+)	System	Sub-system	Description	Eligibility Requirement	Further Information	Effective Useful Life (EUL)	Source for EUL
Hydraulic System CONTINUED								
HS 5 – Toilets Efficient unit replacement	Water +	Hydraulic system	Toilets	A range of 5 star WELS rated toilets are now available on the market. This rating is based on overall efficiency of water use of the system. There are significant water efficiency savings that can be made by installing new efficient systems. Some units contain integrated hand basins. They provide similar water savings as other highly rated toilets, but provide for the additional capacity of washing your hands. The fresh water used to wash your hands, turns into grey water and is used to flush the toilet.	Minimum 5 star WELS rated	www.wels.gov.au www.allianceforwaterefficiency.org http://www.melbournewater.com.au/content/water_conservation/water_conservation.asp Water use and sustainable commercial buildings (http://www.yourbuilding.org/Article/NewsDetail.aspx?p=83&id=1584)	10+ years	Watersmart Guidebook (EBMUD 2008)
HS 6 – Urinals Efficient unit replacement	Water +	Hydraulic system	Urinals	Conventional water-flushed urinals are water intensive. Multiple stalls connected to one flushing device use between five litres and 20 litres a flush. In addition, these units may be set to flush automatically, whether this be on a pre-set timer, an infra-red sensor or otherwise. This can lead to unnecessary flushing, and further wastage of water. Modern low-flow, or waterless urinals, with a manual or smart-demand flushing system, can significantly cut the volume of water used per flush, and remove unnecessary flushing, resulting in large reductions in water usage.	Consumption < 1.0 L/flush or waterless	www.wels.gov.au www.allianceforwaterefficiency.org http://www.melbournewater.com.au/content/water_conservation/water_conservation.asp http://www.sydneywater.com.au/Publications/_download.cfm?DownloadFile=FactSheets/WaterlessUrinalsFactSheet.pdf Water use and sustainable commercial buildings (http://www.yourbuilding.org/Article/NewsDetail.aspx?p=83&id=1584)	10+ years	Watersmart Guidebook (EBMUD 2008)
HS 7 – Urinal flush control	Water +	Hydraulic system	Urinals	A urinal flushing control system is a device that controls the release of water to flush a urinal. Such devices are classified by how they are operated as follows: a) Conscious operation. Operated manually by the user. b) Demand-driven operation. Operates automatically on demand, rather than by conscious activation of a user, with an adjustable activation sensitivity field at the front of the urinal or a urine-sensing device. c) Smart-demand operation. Programmable operation with an adjustable activation sensitivity field at the front of the urinal or a urine-sensing device to control a predetermined flush cycle, with smart logic that detects users, and controls programmable delay and flushing modes of the device.	Demand-driven operation or smart-demand operation	Water use and sustainable commercial buildings (http://www.yourbuilding.org/Article/NewsDetail.aspx?p=83&id=1584)	10+ years	Watersmart Guidebook (EBMUD 2008)
Landscaping								
L 1 – Rain shutoff device	Water +	Landscaping	Irrigation System	Rain shut-off devices are designed to stop the irrigation of landscaping in the event of rain. The device is installed in a location where it can receive the full amount of rain that falls, with minimal splashing. For Melbourne's climate rainfall is variable, and can occur throughout the year. As such, the installation of a rainwater shut-off device can reduce water consumption	Commitment to implement improvement.	http://edis.ifas.ufl.edu/ae221	10+ years	Manufacturer
L 2 – Soil moisture sensors	Water +	Landscaping	Irrigation System	A soil moisture system measures the water content in soil. This helps to calculate the minimum amount of water needed to be delivered to landscaping for effective growth. They can be linked to an irrigation controller to stop irrigation when the soil moisture levels are sufficient	Commitment to implement improvement.	www.irrigation.org.au	7 years	Manufacturer