CUSTOM LIST OF IMPROVEMENT EXAMPLES 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
Heating, Ventilation & Air Conditioning (HVAC)								
Cus_HVAC 1 – Airflow distribution improvements	Energy +	HVAC	AHUs	Older air distribution systems can be inefficient with regard to fan energy and heating and cooling loads. High air velocity in many older buildings result in system pressures that are no longer acceptable in common practice HVAC design. These high system pressure result in high fan energy and often result in higher noise levels in the occupied space. Alterations or replacement of on floor duct work can result in a lower pressure system and hence lower fan energy. Old dual duct air-distribution systems mix warm and cool air to control temperature in the space. Due to space inefficiency of dual duct systems air-side velocities were generally high as were system pressures. In addition to this dual duct systems controlled temperature by mixing warm and cool air. In this way systems were generally heating and cooling simultaneously which is an energy inefficient method for conditioning a space. These systems can be converted to modern day single duct variable air volume (VAV) system, which will save fan and heating and cooling energy. A number of older air distribution systems are constant volume air flow. This means that regardless of cooling/heating demand the same amount of air is sent to the space. Fan and heating and cooling energy efficiency can be found when constant volume air systems are converted to VAV. Beyond this completely new on floor works may be considered including measures such as chilled beams, VAV or underfloor air distribution.	Refers to the replacement/improvement of air distribution systems. For the systems – if being replaced in upgrade – should comply with the following performance list (Derived from AIRAH Technical Handbook): Air side Systems: All to meet BCA 2010 Section J requirements Riser/dropper ducts – max velocity of 3.0m/s On floor ductwork – max velocity of 3.0m/s Cooling/heating coil – max face velocity – 2.25m/s Air filters – max face velocity – 1.8m/s Across VAV box dampers – design flow velocity approximately 7m/s Air register – Max neck velocity for air registers – 2.5m/s	AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment 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
Cus_HVAC 2 – Provide digital control system to monitor and control all plant	Energy +	HVAC	Energy Management Controls	Building management systems (BMS) control the operation of mechanical, electrical and lighting systems. Effective control of these systems is essential to efficient operation. New digital BMS systems with remote and internet connectivity have far greater capacity to implement energy efficient control strategies. New BMS control system should especially be considered when building owners are investigating a major overhaul of existing HVAC and lighting systems.	System installed must be specifically programmed to optimise environmental performance. Commissioning of the system for environmental performance optimisation is a mandatory implementation activity.	AIRAH Technical Handbook ASHRAE Application Guide ASHRAE HVAC Systems and Equipment 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	To be provided by applicant. Likely to be based on guarantees from installer or manufacturers.
Cus_HVAC 3 – Offset existing mechanical cooling	Energy +	HVAC	Evaporative Cooling Systems	Evaporative cooling is used to cool air through the evaporative effect of water. Air is blown over a wetted pad, which reduces the air temperature and increases the moisture level. As Melbourne is prone to hot, dry (low humidity) summers evaporative cooling is particularly effective in this climate. When compared to traditional mechanical cooling, evaporative cooling has a much lower energy usage (only using a pump and fan), however has an associated increase in water usage. This item also has potential to significantly change occupant comfort in building. Early tenant engagement and engagement of an experience building HVAC engineer will be essential to successful implementation of an evaporative cooling scheme. Care must also be taken to ensure that build up of moisture and humidity in the space is kept under control. As such other active cooling/dehumidification system may need to be considered in tandem to evaporative cooling systems.	Evidence of tenant agreement to a more adaptive comfort profile, based on revised comfort levels that evaporative cooling system can provide based on advice from building services engineer. Evaporative cooling strategy in the form of a design concept with evidence of provision for management of space humidity levels.	CIBSE Guide A – Environmental Design	10+ years	To be provided by applicant. Likely to be based on guarantees from installer or manufacturers.
Cus_HVAC 4 – Demand controlled ventilation	Energy +	HVAC	HVAC System (General)	Buildings provide a source of outside air to occupants for health reasons. Without a source of fresh air, the oxygen breathed by humans will lead to a rise in carbon dioxide levels. In addition the lack of outdoor air can cause issues with odour and comfort. In order to overcome this outside air is provided through the buildings air conditioning system, usually at a constant rate determined by the maximum design load for occupants within the buildings. As for the large majority of the Melbourne year outdoor temperatures lay outside the internal temperatures of an office, some additional cooling or heating is required before this air can be delivered into the building. CO_2 sensors minimise this heating and cooling by measuring the amount of CO_2 in the air (and hence, indirectly, the level of occupancy of the building) and delivering only enough fresh air to provide sufficient ventilation. This can lead to a reduction in energy use for buildings that are not fully occupied at times.	System must comply with AS1668.2 System to be control to a maximum CO_2 level in occupied space of 800PPM (As outlined in Green Star v3 IEQ-1)	AS1668.2 Green Star v3 – IEQ-1 BSRIA TN12/94.1 CO_2 Controlled Ventilation Systems 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
Cus_HVAC 5 – Duct testing and sealing	Energy +	HVAC	HVAC System (General)	Air travelling through ducts to condition a space is a result of fan energy pushing it through ducts and chiller or boiler plant energy to condition the air. Air leaked from the system before it is supply to the space impacts HVAC energy in all major plant items up the line. Minimising duct leakage will reduce HVAC energy wastage and provide a more efficient and effective HVAC system.	CIBSE Commissioning Code A – Air distribution Systems Must involve new building works including: duct sealing, new duct sections etc. Cannot be a stand alone duct testing exercise.	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

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Heating, Ventilation & Air Conditioning (HVAC) CONTINUED								
Cus_HVAC 6 – Geothermal HVAC	Energy + Water +	HVAC	HVAC System (General)	A geothermal HVAC system involves pumping heat to, or from, the ground, using the earth as a heat source/sink. As the temperature of the ground is a fairly constant, moderate temperature throughout the year this is an effective way of producing heating and cooling. This can be a vertical or horizontal closed loop system, or an open loop system pumping water from a natural body. In Melbourne this type of system will access temperatures that give comparable year round COPs to traditional systems. In winter cooling mode COPs may be better due to warmer ground temperatures than average ambient. There are potential water use savings because this type of system removes the need for cooling towers. As such it may also be considered a water saving measure.	Applicant must demonstrate environmental benefits are achieved.	www.pir.sa.gov.au/__data/assets/pdf_file/.../DirectUseHVAC2.pdf – http://www.yourbuilding.org/library/1_TEC06.pdf – BSRIA BG7_2009 – Heat Pumps – BS EN 15450 – ISO/NP 13612-1/2 (Heating and cooling systems in buildings – Method for calculation of the system performance and system design for heat pump systems)	10+ years	TEC Environment Design Guide
Cus_HVAC 7 – VAV system conversions	Energy +	HVAC	HVAC System (General)	A variable air volume system is an all air-based air conditioning system, which supplies air at a constant temperature to a number of VAV terminal outlets within a building. The VAV unit controls a damper which can modulate the volumetric flow rate to the zone, dependant on the load. For example, in Melbourne, an East facing zone would have a higher flow rate in the mornings then a West facing zone. When compared to a constant volume system, the reduction in fan energy, and the need to re-heat less can lead to excellent energy savings.	CIBSE Commissioning Code A – Air distribution Systems	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
Cus_HVAC 8 – Radiant Heating / Cooling	Energy +	HVAC	On floor services	Radiant heating and cooling is more effective in comparison to traditional convective systems that require fans to blow conditioned air into the space. Chilled ceiling panels can be used to provide cool conditions on hot summer days. Chilled beams using a similar method can be used to provide targeted cooling near windows to counteract solar heat gain without the need for air supply ducts (passive chilled beams). Radiant systems are more responsive in modifying thermal conditions for occupants and the adjustment can be more readily felt. Humidly control in the occupied space may be necessary for all chilled beam systems to avoid condensation on the chilled surface. Note that chilled ceilings can provide heating to at least 1.5 x their cooling capacity – so they are good for cold winter areas too.	Test and improve building sealing if high infiltration, this will ensure infiltration can be controlled to manage humidity effectively. Refer eligibility requirements for this *Test and reduce Building infiltration/ exfiltration* improvement. Provide appropriate engineering design analysis demonstrating that the system will result in improved occupant thermal comfort (satisfaction) and reduce building greenhouse gas emissions.	Handbook of radian heating and cooling, R. D. Watson, K. S. Chapman, McGraw-Hill, 2002 ISO/DIS 11855-1/2/3/4/5/6 (Building environment design – Design, construction and operation of radiant heating and cooling systems)	10+ years	To be provided by applicant. Likely to be based on guarantees from installer or manufacturers.
Electrical								
Cus_E 1 – Replace with LEDs	Energy +	Lighting	Interior Lighting	LEDs are a fast developing technology. They are widely used in consumer products and a number of specialty lighting applications. At present LED lighting systems are uncommon in full office fit outs. There are however a number of attributes that LEDs possess that are driving them to the forefront of lighting design. Namely these include, efficiency and controllability of light distribution, service life and colour render properties. LEDs are not appropriate in a like for like swap with traditional fluorescent lighting systems. There are however significant opportunities in full lighting redesign situations, where LEDs will provide a highly energy efficient, low maintenance and effective outcome.	Design report showing the energy efficiency benefits of the new lighting system in which LEDs may play a major or minor role in combination with other high efficient lighting fixtures (see common measures for lighting).	The IESNA Lighting Handbook – Reference and Application	5-10 Years	The IESNA Lighting Handbook – Reference and Application
Cus_E 2 – Fuel Cell	Energy +	Electrical	Building integrated generation	Fuel cell technology is a viable alternative to internal combustion engines or turbines for building integrated combined heat and power (CHP) applications. There are a number of commercial available fuel cell generators that are designed to operate on natural gas. Not recommended as a common measure. Depending on the load profile of the building, this may not lead to a decrease in greenhouse gas emissions. Should be done as a custom measure.	To be eligible: – Proposed improvement must be a combined heat and power system e.g. cogeneration or tri-generation. – Submission must include a consultants report detailing system size, intended operation and design concept based on existing building infrastructure and load profile. – System sizing must be based on heat loads either from existing demands or from absorption or adsorption chiller system.	http://www.industry.nsw.gov.au/energy/sustainable/efficiency/cogeneration http://www.cleanenergycouncil.org.au/cec/technologies/cogeneration.html http://www.csiro.au/files/files/ptza.pdf http://www.cibse.org/pdfs/4b%20John%20Lidderdale.pdf	10+ years	Manufacturer
Cus_E 3 – Microturbine	Energy +	Electrical	Building integrated generation	Micro-turbines are becoming increasingly popular in the CHP marketplace. This is largely due to their compact packagability, modularity and perceived simplicity of design. In Australia these units are most commonly natural gas fired engines. In Victoria, where electricity is supplied primarily by brown coal fired generation, there is the potential for significant greenhouse gas emissions savings by implementing gas fired CHP. Due to current regulations regarding electrical feed in to grid from distributed rotating generators, systems may need to be used to supply base building electricity only. In this situation it is critical that generators are sized appropriate to building loads. If oversized, the generator may never be able to be operated and return on capital outlay is lost. Specialist design engineers should be employed to correctly size and set up control of CHP systems. Not recommended as a common measure. Depending on the load profile of the building, this may not lead to a decrease in greenhouse gas emissions. Should be done as a custom measure.	To be eligible: – Proposed improvement must be a combined heat and power system e.g. cogeneration or tri-generation. – Submission must include a consultants report detailing system size, intended operation and design concept based on existing building infrastructure and load profile.	http://www.industry.nsw.gov.au/energy/sustainable/efficiency/cogeneration http://www.cleanenergycouncil.org.au/cec/technologies/cogeneration.html http://www.csiro.au/files/files/ptza.pdf	10+ years	Manufacturer

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Electrical CONTINUED								
Cus_E 4 – Internal Combustion Engine	Energy +	Electrical	Building integrated generation	Internal combustion piston engines are the most well developed, versatile generation technology in the modern world. They are also the most common technology used in building integrated combined heat and power (CHP) applications. In Australia these units are most commonly natural gas fired engines. In Victoria, where electricity is supplied primarily by brown coal fired generation, there is the potential for significant greenhouse gas emissions savings by implementing gas fired CHP. Due to current regulations regarding electrical feed in to grid from distributed rotating generators, systems may need to be used to supply base building electricity only. In this situation it is critical that generators are sized appropriate to building loads. If oversized, the generator may never be able to be operated and return on capital outlay is lost. Specialist design engineers should be employed to correctly size and set up control of CHP systems. Depending on the load profile of the building, this may not lead to a decrease in greenhouse gas emissions.	To be eligible: – Proposed improvement must be a combined heat and power system e.g. cogeneration or tri-generation. – Submission must include a consultants report detailing system size, intended operation and design concept based on existing building infrastructure and load profile.	http://www.industry.nsw.gov.au/energy/sustainable/efficiency/cogeneration http://www.cleanenergycouncil.org.au/cec/technologies/cogeneration.html http://www.csiro.au/files/files/ptza.pdf	10+ years	Manufacturer
Renewable Energy								
Cus_RE 1 – Grid Tied Wind Turbine	Energy +	Renewable Energy	Wind	Building integrated micro wind turbines have been employed around the world with varying degrees of success. Where local wind resource is strong and consistent, results can be a cost effective source of low carbon energy. However, the localised nature of wind resource and the effect of the urban environment can make predicting successful locations and installations difficult even for professionals. It is suggested that building owners considering micro wind consult professionals and have on site testing completed prior to moving forward with investment decisions. Note also that wind turbines can impose significant structural loads to the surface they are being mounted on. As such a structural assessment of the proposed turbine location on a building will be necessary.	Installed by Clean Energy Council approved installer. Applicable to government solar credits program. Present a business case for the wind turbine installation based on local wind resource testing. Structural assessment for mounting of wind turbines on the building.	http://www.ata.org.au/basics/baswind.htm	10+ years	Manufacturer