Proposed Ecologically Sustainable Design Initiatives

Mixed Retail, Commercial and Residential Development Part 3A Application

Lot 11 DP 774322 and Lots 6-8 DP 977044
78 to 90 Old Canterbury Road, Lewisham

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REPORT APPROVAL

Approved by: Behrooz Shojaei *B Shojaei* Date: 25/10/2010

(Cardno ITC)

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1 INTRODUCTION

Cardno ITC was engaged to conduct a desktop study to address the Director General Requirements (DGR's) in relation to development at 78 to 90 Old Canterbury Road, Lewisham proposed by Lewisham Estate Pty Ltd. The site currently forms part of a Master Plan Study by Tony Owen Partners.

1.1 Proposal Description

The Concept Plan is for a Major Project comprising a mixed use development for residential, commercial and retail land uses with associated car parking facilities and public domain improvements. The Concept Plan is for buildings ranging in height from 4 to 9 storeys with a maximum overall FSR of 3.5:1. Public domain improvements include the creation of new streets, open space areas and pedestrian access points

Figure 1-1 identifies the entire site forming part of the Tony Owen Partners Masterplan, as well as nearby infrastructure and receivers.

This desk top study will address the Environmentally Sustainable Development (ESD) initiatives which are over and above options as well as standard efficiency options (such as water efficient taps, timers on fans, CO2 monitoring to carpark, energy efficient lighting, etc.) which would be incorporated in the base design to achieve BCA – Section J and mandatory BASIX / NABERS requirements.

2 LOCATION

2.1 Site Description

The subject site is located at 78-90 Old Canterbury Rd, Lewisham, which is legally described as Lot 11 in DP 774322 and Lots 6-8 in DP 977044. The site is an irregular shaped allotment that is currently occupied by an assortment of industrial buildings. As described in Figure 1, the site is bounded by Longport Street to the north, Old Canterbury Road to the east, Hudson Street to the south and a green corridor (redundant freight railway corridor) to the west. A few outbuildings are located within the green corridor to the west and attached to the western boundary alignment of the subject site. The north eastern corner of the site is bounded by William Street and Brown Street. The site has a total area of 13,115sqm

2.2 Surrounding Topography and Conditions

The site is at a low point on the surrounding topography with higher level surroundings on both the east and west elevations. Surrounding buildings are primarily low rise (2 storey's or less) which provide minimal to no external shading onto the site.

Proposed Development

Source: Tony Owen Partners, October 2010

3 OBJECTIVES

Environmental sustainability for the proposed development has been considered in accordance with the following ESD principles:

- Reducing greenhouse gas emissions (energy conservation) through passive building design, efficient services and renewable energy generation;
- Maximising indoor environmental quality (IEQ) factors such as internal air quality, light and comfort, which are key considerations for a café;
- Water conservation and management;
- Careful selection of materials to maximise recycled content and reduce environmental impacts;
- Minimising natural resource consumption, waste, pollution and toxicity during the refurbishment and operation of the facility.

It is also recognised that the development of ESD solutions will be an integrated approach with the architecture and the building services.

3.1 Integrated Design Approach

The integrated design process is a process by which all of the design variables that affect one another are considered together and resolved in an optimal fashion. Often referred to as holistic design, it looks at the development as a whole with the emphasis on integrating the different aspects of building's design.

For instance day lighting, natural ventilation and water conservation cut across multiple disciplines. Day lighting in particular affects virtually every design discipline including architecture (building envelope and orientation), mechanical (reduced internal heat loads and modified fabric loads), electrical (lighting design and lighting controls), structural (floor-to-floor heights and external shading) and interiors (interior colours and reflectivity).

Each of these key points are interrelated, a building with good daylight will provide better occupant comfort and well-being as well as reducing energy consumption.

4 ENERGY & EMISSIONS

Greenhouse gas emissions are directly related to energy consumption. In Sydney, for every 1.1kWh of mains electricity consumed, approximately 1kg of CO_2 is released into the atmosphere.

4.1 Integrated Energy Approach

Greenhouse reductions are achieved in a staged approach:

- First, reduction in overall energy consumption through demand reduction and energy efficiency, then;
- Reduction in electricity and gas utility consumption by utilising waste products and renewable energy technologies.

4.2 Energy Efficiency Breakdown

Below is a breakdown of areas within the development and the major contributors to energy consumption within each of the spaces:

AREA	ENERGY CONSUMER
Residences	Lighting
	Refrigeration
	Ventilation and Air-Conditioning
	Domestic Hot Water
	Supplemental System (e.g. television, etc.)
Lobby	Lighting
	Computers and Supplemental Equipment
	Ventilation and Air-Conditioning
Lifts	Lighting
	Lifts
Restaurant	Lighting
	Ventilation and Air-Conditioning
Plaza	Lighting
	Ventilation and Air-Conditioning
	Cooking Processes
	Freezer and Refrigeration
	Hot Water

Pool	External Lighting
	Heating
	Pumps
Gymnasium	Lighting
	Air-Conditioning
Grounds	External Lighting
Function Spaces	Lighting
	Air-Conditioning
Carpark	Lighting
	Ventilation (if underground)

As noted in the last page the primary energy consumption items are:

1. Lighting;
2. Heating, Ventilation and Air-conditioning;
3. Hot Water.

The integrated response to energy proposed for this project is summarised below:

1. Load Reduction and Passive Design
2. System Efficiency
3. Capture Waste
4. Renewable Energy power generation/ Rainwater harvesting

Energy consumption can be reduced through the efficient design of lighting, air-conditioning and ventilation systems, as well as water heating and other services. This development will consider Green House Gas emission reduction in design and operation, utilising the following initiatives.

Energy Consumer	Load Reduction & Passive Design	System Efficiency	Capture Waste & Utilising Renewable Energy Sources
Lighting	Daylighting to reduce reliance on artificial lighting. Selection of energy efficient lighting	Fluorescent or LED lighting where possible with lighting control systems (timers, daylight dimming, etc) 35 W IRC Halogen Down lights where possible instead of 50W Halogen Down lights.	Photovoltaic (Solar Electricity) panels to be considered to offset some parts of the load.
Heating, Ventilation & Air-Conditioning	Passive design (shading, insulation, glazing type, thermal mass etc)	Mixed mode ventilation systems comprising of energy efficient air-conditioning systems and natural ventilation cooling.	Photovoltaic (Solar Electricity) panels will be considered to partially offset the load.
Hot Water	Instantaneous systems over storage units and gas/solar over electric.	Utilising energy efficient hot water systems as well as low flow fixtures and fittings.	Solar panels (with gas-boost) will provide all hot water.

5 ECOLOGICALLY SUSTAINABLE DEVELOPMENT (ESD) INITIATIVES

5.1 Building Fabric Initiatives

Insulation

Insulation reduces the heat transfer between the internal and external conditions. Adequate insulation in the ceiling and walls would reduce the heating and cooling load of the buildings and would reduce the ongoing operational costs. This has a twofold saving through a smaller mechanical system capacity along with operating energy consumption reduction.

Glazing and Window Framing

Double hung timber frame windows would be installed to reduce heating and cooling energy consumption and maintaining occupant comfort through natural ventilation. Glazing may be described by the following properties:

- Visible Light Transmission (VLT): the percentage of visible light transmitted by the glass.
- Shading Coefficient (SC): the percentage of solar radiation that is transmitted through the glass.
- U-Value: a measure of how much heat is passed through the glass.

Selecting glazing with a low SC will help to avoid heat gains in the summer, while glazing with a low U-value reduces losses in the winter through the glass. Incorporating effective shading features into the design can avoid the necessity for low shading coefficients in the glass, which usually also decrease the VLT of the glass. To maximise the natural daylight within the buildings, VLT would be as high as possible.

5.2 Indoor Environmental Quality Initiatives

Thermal Comfort

Thermal comfort is a function of the following factors:

- Radiant temperature – the temperature of the surfaces around you, or radiant heat from the sun etc (45% of net comfort effect);
- Air temperature and humidity (35% of net comfort effect);
- Air movement, clothing & activity (20% of net comfort effect).

Thermal comfort can either be provided by passive or mechanical means. Passive means have been optimised before the design of the mechanical systems to reduce operational energy costs, with potential reductions in the Air-conditioning size and ongoing maintenance.

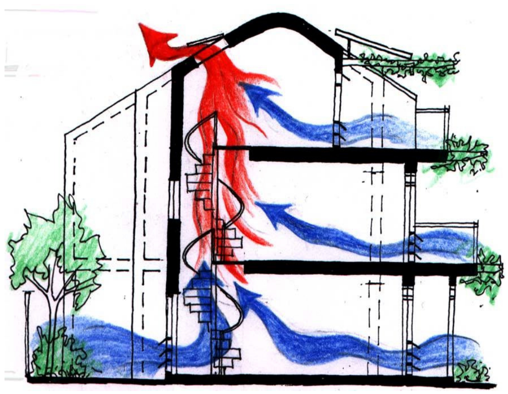
Passive heating and cooling strategies incorporated into the design, which will improve occupant thermal comfort include:

- Roof insulation not only reduce heat gain and loss, but will also moderate radiant temperatures from the walls, floor and ceiling;
- Building facades with high performance glazing and window frames will have a combination of external shading and high-performance glass to reduce heat transfer and radiant temperatures in proximity to the windows;
- Air temperatures through the use of significant ventilation openings within the façade.

Thermal comfort index and PMV (Predicted Mean Vote) should be considered at the design stage to meet the requirements for each individual building.

Natural Ventilation and Air-Change Effectiveness

Adequate ventilation is critical to the performance of this development. The cross ventilation system proposed relies on cooled filtered air being provided by surrounding vegetation and landscaping. This cooled and filtered area is then drawn through the apartments via convection. The façade openings would be small, top-hung and set low in sets of two or three to draw in the low lying cooler air. Purpose designed vents, high level louvres, or ventable skylights would then be used to exhaust warm air at the top of the rooms, creating outlets for the thermal flues that are formed by the stairwells, thermal chimneys or centralised ducts. The illustration below depicts the concept proposed in more detail:



Surrounding vegetation would improve the effect of Natural Ventilation especially during summer months.

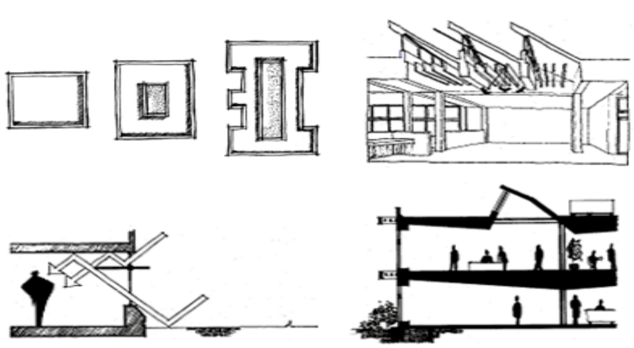
Please note that the potential acoustic issues associated with this option would also need to be reviewed with the acoustic consultant.

Effective Daylighting/ Natural Lighting

Daylighting is the architectural and services design to allow maximum daylight penetration into a building whilst minimizing heat gain and thereby reducing indoor lighting loads.

Daylighting strategies combined with dimmable lighting systems would allow high control of indoor lighting levels whilst minimising power consumption for the buildings.

Size and location of the existing windows facilitate a high level of daylight harvesting for the buildings, it may not be feasible to add new windows without influencing the heritage nature of this building. The illustration below depicts the concept in more detail:



A high level of architectural input in regards to design, orientation and external shading is required to effectively maximise daylight potential.

5.3 Materials Initiatives

Environmentally Sensitive Products

To minimise the environmental impact of the buildings, preference should be given to environmentally responsible materials during the selection process, according to the following principles:

- Avoidance of ecologically sensitive products (such as scarce minerals and old-growth forest)
- Selection of materials with a low embodied energy & high recycled content;
- Low toxicity material selection;
- Low impact on the indoor environment;
- Durability, flexibility and recyclability;
- Emissions in manufacture and composition, including greenhouse gases and ozone depleting substances.
- Waste reduction – utilising prefabricated construction can minimise construction work and waste on site.

Ozone Depletion Materials

Selection of insulation should be targeted to minimise both Ozone Depletion Potential (ODP).
The current market has zero ODP insulation on the markets which are highly recommended due to the reduced impact on the environment.

Concrete

Traditional Portland cement production has a considerable embodied energy impact, which can be mitigated by replacing a proportion of cement with an industrial waste product such as fly ash.

Design development should consider the following cement replacement targets, subject to structural considerations:

- Replace 20% of cement with an industrial waste product;
- Use 20% recycled aggregate.

Timber

Where possible, all timber should be supplied from sustainable sources including Forestry Stewardship Council (FCS) certified plantation timbers and recycled products. No timber (either solid or veneer form) should be sourced from rainforests or old-growth forests.

PVC Minimisation

PVC is being phased out in the European Union, as there is widespread evidence to its harmful environmental impact, particularly during disposal or fire. PVC is used in almost all electrical and data cabling and for drainage pipework. Australia does not have any provision for safe recycling or disposal of PVC and it is encouraged that alternatives be considered: Alternatives to PVC products include:

- HDPE and polypropylene pipe work instead of PVC pipe for water supply and drainage systems;
- Linoleum and other natural products instead of vinyl floor coverings;
- Composite materials for electrical cabling.

Finishes

Contamination of indoor air by common indoor pollutants should be reduced in this development by careful material selection, including:

- Use of low-VOC and water-based paints rather than oil-based paints, stains or sealants, reducing indoor air contamination and consequent side-effects including sick-building syndrome and respiratory problems;
- Selection of low-VOC carpets and adhesives;
- Selection of low formaldehyde composite wood products, avoiding the carcinogenic effects of formaldehyde off-gassing;

Volatile Organic Compounds (VOC) & Formaldehyde Minimisation

To ensure long term comfort of occupants, all due care should be taken to minimise VOC and formaldehydes installed within the construction of the café.

VOC's are commonly found in carpets, paints, adhesives and sealants uses in construction and extensive exposure to VOC's can cause Sick Building Syndrome effects (eye, nose and skin irritation, headaches lethargy etc).

Formaldehydes are found within composite wood products and extensive exposure can cause irritation to eyes, nose and throat, lead to skin ailments and respiratory system ailments such as asthma.

5.4 Energy Efficiency Initiatives

Efficient Artificial Lighting

An efficient lighting design and control strategy would reduce artificial lighting energy consumption and allow maximum advantage to be taken of daylight. Lighting power density will be required to meet BCA requirements.

- Efficient light fittings including T5 fluorescent lamps or compact fluorescent lights (CFLs).
- Low-power LED lamps can be used in feature lighting and are now available with excellent colour temperature control.
- Daylight dimming of external and streetscape perimeter lighting, as well as internal lighting adjacent to windows;
- Efficiency controls including timers and motions sensors in infrequently used areas.

To minimize energy consumption from external lighting all externally-lit spaces over the entire site should meet the following criteria:

- All external lighting has a light source efficacy of at least 50 lumens/watt;
- 95% of outdoor spaces meet or exceed the minimum requirements of AS1158 for illuminance levels; and
- 95% of all external lights are connected to daylight sensors (daylight sensors can be combined with a time switch).

Efficient Heating, Ventilation & Air-Conditioning

Heating and cooling of the building will make up a large proportion of the building's energy use throughout the year. Several options for the HVAC systems will be investigated. This report outlines and evaluated some of the typical heating and cooling strategies. The layout and type of the development will allows either a localized package or split unit design, or a centralised energy plant design where the thermal energy is generated centrally and then distributed around the development. Recommendations made based on efficiency of the system, capabilities of the system as well as expected installation and operation cost.

The Lewsiham development is primarily a residential building. But as part of this type of development, other areas such as passage ways, common areas and other specialised areas exist. Heating and cooling demands of the building vary with each type of area of the building, as different occupancy rates, types of activity and other factor such as equipment loads will affect the necessary levels of heating and cooling.

The different areas of the development have been grouped together into different building types in order to accurately estimate the heating and cooling demands of the development.
The types of areas are as follows:

Residential – include the apartments and living areas,
Retail and commercial -
Circulation – includes all the common corridor type areas,
Common – includes the lounge and other areas common between residents,
Pool – includes the pool and gym areas

HEATING AND COOLING OPTIONS

Heating and cooling energy can be provided in a number of different ways for the Lewisham development. The layout of the development will allow for either a localized equipment setup or a central energy plant setup.

A localised equipment setup means that the equipment responsible for producing the necessary thermal energy is located in or near the zone which is being conditioned. For this development, this means the equipment will be located within each apartment and common areas. The size or capacity of each piece of equipment is just enough to satisfy the demands of that particular zone. Extra equipment may be necessary to complete the system, which can be located centrally, however the primary thermal energy producing equipment is located locally.

A central energy plant, also known as a primary plant, is where the equipment producing the thermal energy is located within a centrally located plant. This plant is responsible for producing the thermal energy for the entire development. This thermal energy is distributed out around the development to each zone or apartment. Extra equipment is required in each zone to complete the system; however the primary thermal energy producing equipment is located in the central plant. Three particular HVAC options have been assessed for use in the Lewisham development:

1. Water sourced packaged unit with air cooled water cooler and boiler

2. Four-pipe fan coil units supplied by a central energy plant

3. Split, air cooled reverse cycle air conditioners

Option 1 and 3 are localized systems whereas Option 2 is a central plant system setup.

Option 1: Water sourced packaged unit with air cooled condenser and boiler

A ducted package unit is a self contained unit which can provide heating and cooling to a single or multiple rooms. A unit typically contains components such as a compressor, heat and cooling coil, fan and filters.

To complete the system, an air cooled cooling coils and a boiler, which can be centrally located serving multiple packed units, needs to supply condenser water to the packaged units. This would be achieved by a 2 pipe network system – 1 delivery and 1 return, connecting each packed unit to the centrally located cooling coils and boiler.

The packaged unit setup allows individual and independent heating and cooling control for each apartment.

The system also achieves high energy efficiency with the potential for heat recovery between apartments. Heat recovery is a process used in a situation where some apartments require cooling and other require heating. The heat produced from the cooling process in some apartments is used in the heating production process in the apartments requiring heating. Such a situation is most likely to occur in shoulder seasons where north facing apartments may require cooling and south facing apartments require heating. Heat recovery can greatly increase the efficiency of the system.
The packaged unit can be located in the ceiling space of each apartment, usually above the laundry, bathroom or other less frequented area of the apartment. The conditioned air is supplied to each room via ductwork running through the ceiling space.

The current trend has been to use air cooled systems instead of water cooled systems. This has been driven largely by the risk of Legionnaires Disease and an increasing awareness of the high rates of water consumption from water-cooled systems. Although water is conserved, certain air cooled systems can commit a building to higher energy consumption. Certain air-cooled coolers like the one pictured above use evaporator pads to greatly increase the efficiency when compared to a typical air-cooled system, while not having the disadvantages of a water-cooled system.

Option 2: Four-pipe fan coil units supplied by a central energy plant

It is possible to implement a system that utilizes a central HVAC energy plant. This is where the HVAC heating and cooling energy is produced in one central area and then distributed around the development as the demand requires. The main advantage in such a system is the ability to utilize much larger equipment which is more efficient than using multiple smaller packaged units.

The distribution network is commonly of a 4 pipe design – 2 pipes delivery and
2 return. This means that both heating and cooling energy can be delivered to the apartments at the one time, enabling a situation where some apartments might require cooling whereas others require heating.

If a centrally located energy plant system were to be used, energy meters would need to be installed at each apartment. With the 4 pipe system, two thermal energy consumption meters would need to be used – one for heating and one for cooling energy. Energy meters allow the determination of how much thermal energy is being used by each apartment from the central HVAC energy plant, and therefore the occupants can be charged accordingly. However, whether this is legally enforceable requires further clarification.

Option 3: Split reverse cycle units

A split reverse cycle unit setup is similar to that of the packaged unit in which the HVAC equipment is localized to the conditioned apartment or zone. The split unit setup has the evaporator unit located within the ceiling space of each apartment. Each evaporator unit requires a corresponding condensing unit. Refrigerant pipes connect the evaporator to the condenser, which means the condenser must be located close the apartment or zone, usually not more than 30 meters away, that is being conditioned. The condensing unit is air cooled and therefore needs to be positioned to allow for the required amount airflow for optimal operation.

The split reverse cycle setup allows individual and independent heating and cooling control within each apartment or zone.

SUMMARY AND RECOMMENDATIONS FOR HVAC SYSTEM DESIGN

Three different system options have been outlined for the Lewisham development:

Option 1: Water sourced packaged unit with air cooled condenser and boiler

The packaged unit system setup allows individual and independent heating and cooling control for each apartment or conditioned zone. The system achieves high levels of energy efficiency with potential heat recovery between apartments.

This system setup is recommended for the Lewisham Development.

Option 2: Four-pipe fan coil units supplied by a central energy plant

The Four-pipe fan coil unit setup achieves high levels of efficiency, but requires addition installation and operating costs compared to the packaged unit setup. Energy meter installation and operation is also required for this setup which adds to the installation and operating costs.

This system is therefore not recommended.

Option 3: Split reverse cycle units

A split reverse cycle unit setup is the simplest of the three HVAC options. They offer the lowest installation and maintenance cost. They also offer individual and independent heating and cooling control to each apartment. The disadvantage to this system is low energy efficiency compared to the other two systems. Another is that the condenser units must be located in close proximity to the evaporator units, usually just outside the apartments. This can cause noise problems for the occupants.

This system is therefore not recommended.

5.5 Renewable Energy Initiatives

Photovoltaics

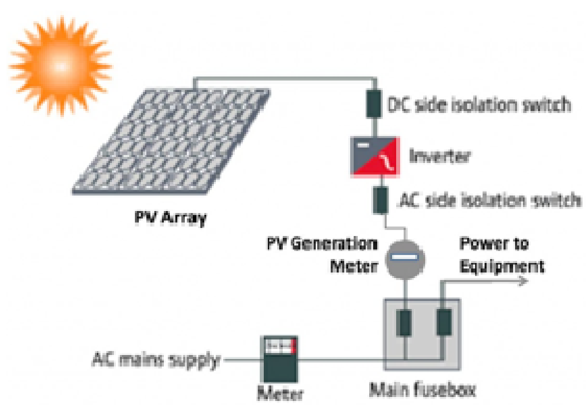
There are many renewable energy sources from which clean energy may be produced and utilised. One of the most cost effective and popular renewable energy technologies for buildings is solar energy and in particular photovoltaic energy (PV), which produces electricity from the sun.

Photovoltaic (PV) panels are devices that convert sunlight directly into electricity. This electricity can be harnessed and used to power any number of devices. Using grid connection, PV panels can export electricity into the electricity grid. The photovoltaic modules can be mounted on rooftops where they will be out of sight and produce the optimum energy output. Alternatively different styles of photovoltaic modules can be incorporated into the building fabric where they can be showcased and offset the cost of building materials. The main benefits of PV systems are that there are no moving parts in the system and they therefore need very little maintenance. PV modules also have a very long lifetime with many manufacturers guaranteeing an output of at least 80% of manufactured capacity for 25 years. Another benefit of PV is that it can be installed in various system sizes wherever there is good access to the sun. The modular design of the systems allows retro-fitting of additional panels as required over the life of the building.

Please refer to the appendix A for further information on various available PV technologies.

A typical layout of a PV system is described in the figure below and includes a PV module array, inverter, energy meter and associated safety devices. The grid connected PV system will supply electricity to the grid. The electricity will be metered and sold to the utility company.

Currently in NSW there is a gross feed in tariff, which allows electric to be sold back to the grid at a price three times higher than it is purchased (current price $0.60 per kWh).



A grid connected solar photovoltaic system.

Domestic hot water (DHW) & Pool Heating

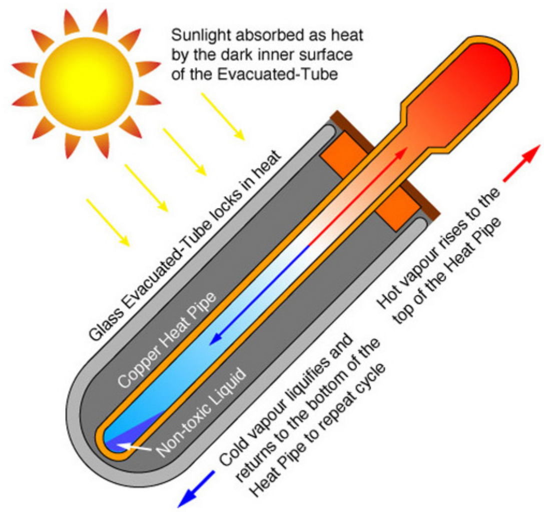
Domestic hot water (DHW) is required for both the residential and common areas of the development. The energy needed to meet DHW demand can be greatly reduced by the use of solar collectors which will be investigated in the report. Two types of system layout will be presented, the first using one central plant room and the other separating the DHW equipment into three plant rooms, one for each building.

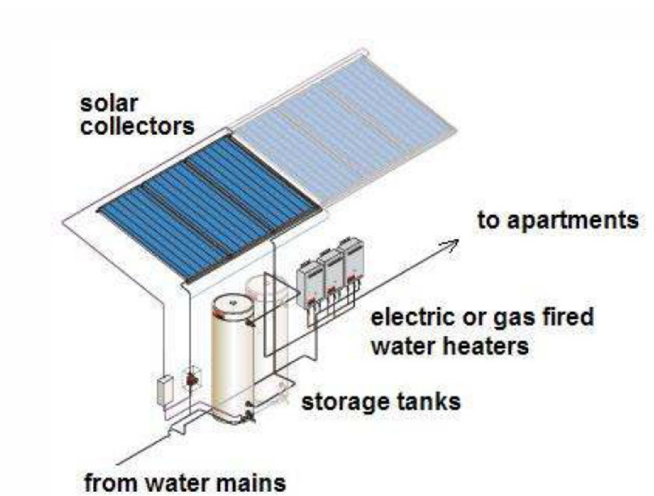
DHW is commonly produced using either an electric or gas fired boiler. However it is becoming common practice to use solar energy to help boost the heating of the water to save either electricity or gas.

System Description

Solar domestic hot water generation is arguably the most common form of harnessing solar energy. DHW can be generated using one of the commercially available solar collector technologies such as evacuated solar tubes or more traditional glazed or unglazed solar collectors.

Evacuated tube hot water panels shown in the figure below, are a vacuum technology with low heat losses and good performance at low sun-angles. These are approximately 20-40% more efficient than standard flat-plate solar collectors.





A solar boosted hot water system comprises of three main components; the solar collectors, storage tanks and the water heaters. Water is brought in from the mains into the storage tanks. From there, the water is circulated through the solar collectors and back to the storage tanks. The water is heated as it passes through the solar collectors. The water is continually passed through the solar collectors and back to the storage tank until it reaches the preset temperature. If, for example, during winter, the water is actually losing temperature from being passed through the solar collectors, the control system will stop this circulation occurring.

When there is a demand for DHW, it is taken from the storage tanks. If the water isn't up to the preset temperature, it is first passed through an instantaneous water heater to bring it up to temperature before it is delivered to apartments.

The instantaneous water heaters are sized to sufficiently meet DHW demand even if the water has not been pre-heated by the solar collectors. This is a possible scenario for a winter day. However, solar boosting the DHW is a very efficient system and can dramatically save on energy costs associated with supply the DHW.

This system is recommended for the Lewisham development.

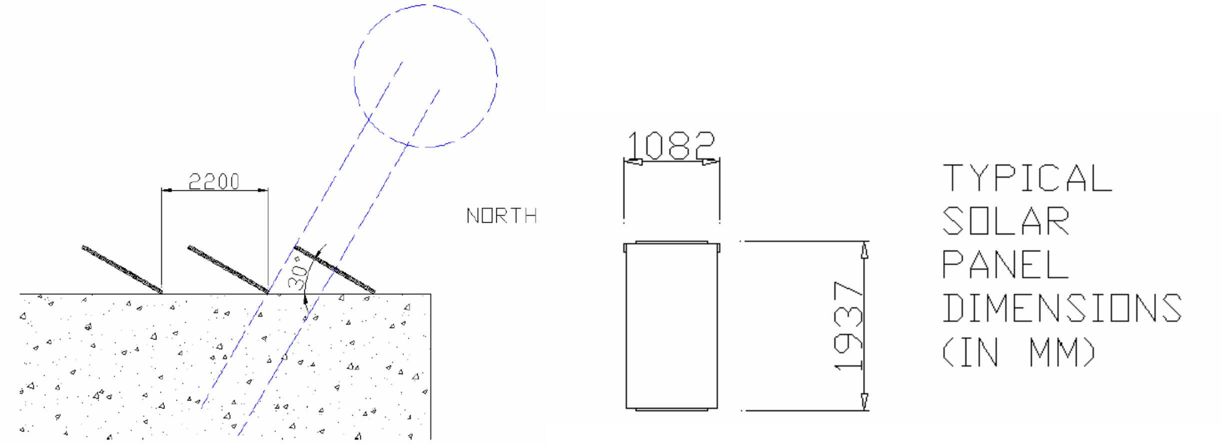
Solar collector installation

The solar collector panels shall be installed on the roof at an angle such as to make the most of the solar energy from the sun. The path of the sun relative to the building will vary throughout the year and therefore it is important to determine an angle which will work best for all seasons.
For this building development, located in Vaucluse, Sydney, the optimum angle will be 30o from horizontal, facing North, as shown in Fig 13 (below).

However, recognising the visual impact of the collectors, this angle may be reduced to suit the architectural design. It is also recommended that the solar collection area is not less than 25% of the total roof area.

Fig 13.

The distance between the panels will need to be 2200mm to ensure that one panel does not shade the panel behind it.



This is based on the typical collector panel size shown below: Fig 14. Typical single solar panel overall dimensions and weight (36kg)

Central plant

A central plant layout for the DHW is system layout where the DHW plant equipment, such as the storage tanks and boilers are located within one central plant room. The DHW is the distributed out to the apartments and other area via a piping network from the central plant. This system would require insulated piping running across the buildings depending on where the central plant would be located.

This system layout would required extensive piping running across the buildings to connect the solar collector to the storage tanks and then to each apartment, therefore this DHW system layout in not recommended for the Lewisham development.

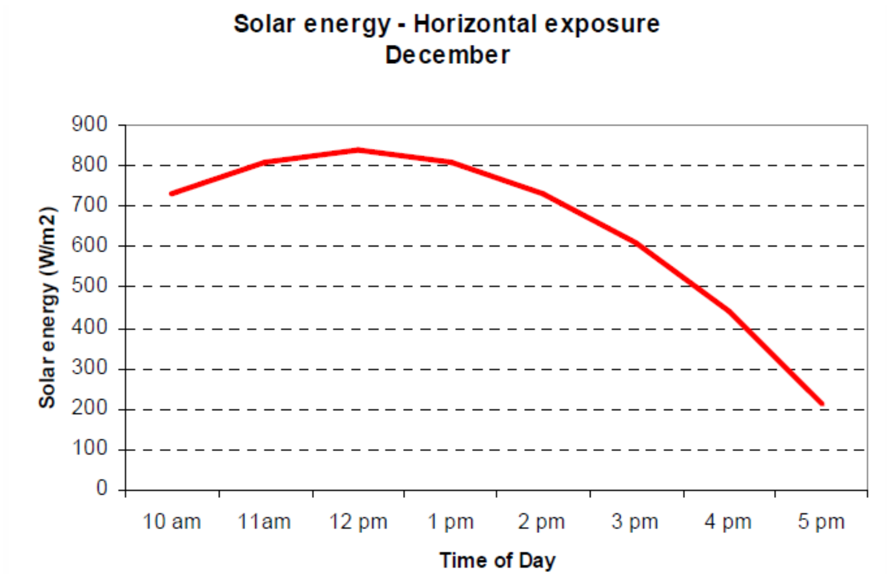
Multiple plants

A multiple plant layout for the DHW is as the name suggests a system layout where multiple smaller plant equipment is located in several plant rooms. For this development, typically three plant rooms would be used in the basement of each building. The DHW would be distributed to the apartments in each building from their respective DHW plant.

This system layout removes the need to connect each building via pipe work as the each plant can serve its own building. Therefore this system layout is recommended.

Availability of Solar Energy for DHW Heating

The following estimate of the projected solar energy contribution towards DHW heating is based on the hourly Global Horizontal (Solar) Radiation data for Sydney. For the purpose of this estimate, it was assumed that solar collectors are installed horizontally.



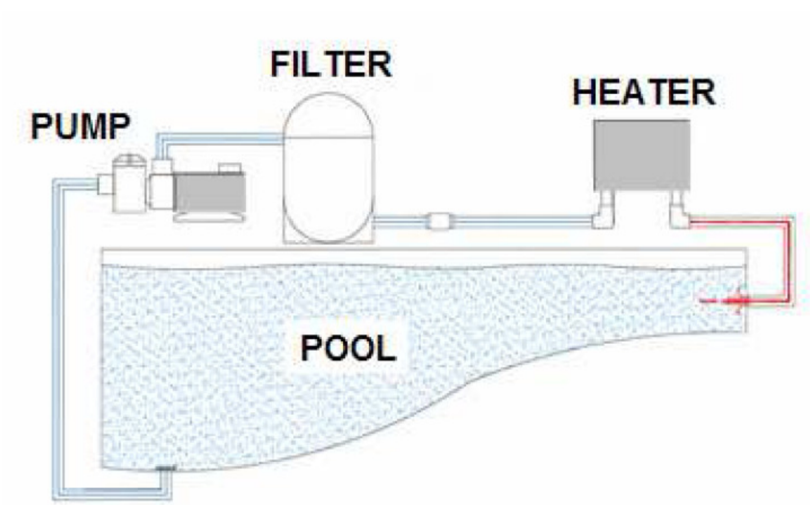
Pool heating

Heating of the indoor pool is another area of energy use which can take advantage of solar energy in a similar way to DHW. Other options such as micro co-generation are another option to be considered.

Heating for the pool can be achieved in a number of ways.

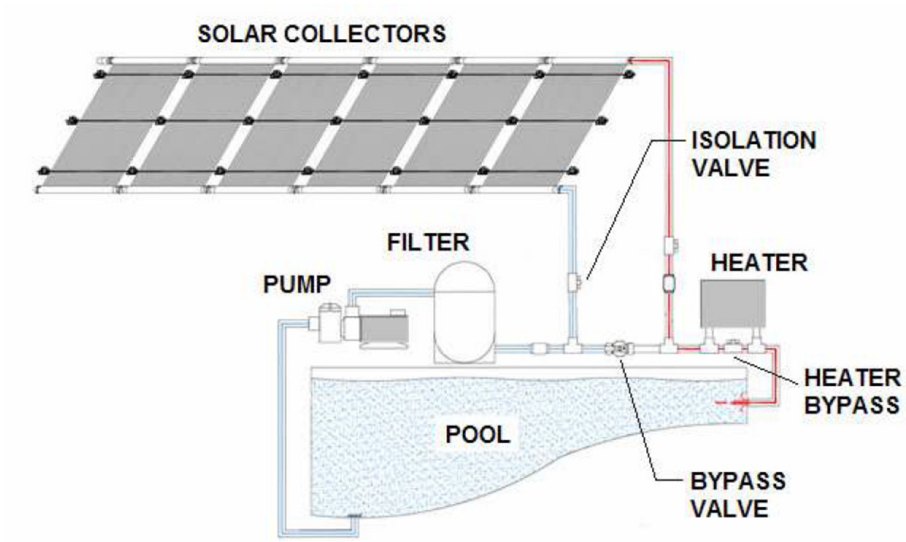
Gas fired or electric boiler

The most simple, traditional way for heating the pool would be the use either an electric or gas fired boiler in a similar way used to produce DHW (see Figure below).



Solar booster pool heating

Solar energy can be used to help heat the water in a similar way to that of the DHW. This is a more efficient system where a solar collector either completely heat or pre-heat the water before it is further heated by either a gas fired boiler or heat pump.
The advantage of a system such as this is that it allows the pool to be headed by solar energy when the weather conditions allow. Valves, controlled by temperature sensors, determine whether there is any need for the gas fired boiler or heat pump. Given a situation where there is no solar energy that can be used i.e. winter, the sensors can control the values so the pool water bypasses the solar collectors and goes straight through the boiler.



5.6 Co-generation

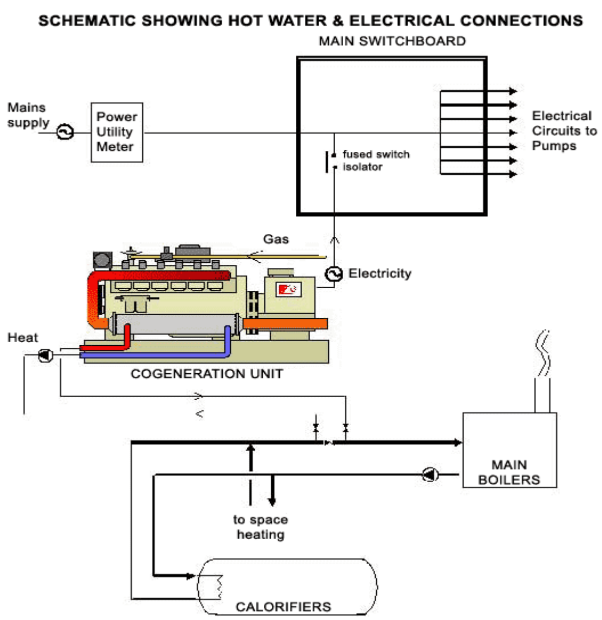
Co-generation is a way of producing electricity and usable heat energy in the one process. A typical system is one where a gas powered engine is used to power a generator to produce electricity. The heat that is a by-product of the gas engine is then used to heat water that can be used for applications such as DHW or pool heating. The electricity produced is used within the development, typically to power common areas.

This solution also permits reduction of mains supply from local authority to the point where a substation onsite may no longer be required. A portion of the space that can be reclaimed by not having a substation onsite could be used to accommodate the gas fired peak demand generators. There is also a possibility of using this system to provide cogeneration. This would be subject to further investigation and discussions with the local supply authorities although the amount of electrical that could be fed back into the grid by this development would be quite minimal.

Peak energy demand reduction will be achieved via gas fired generators that supplement the electrical supply from the grid at peak times.

This solution could also be coupled with the hot water system and/or boilers to provide even greater efficiency.

An example of this concept is depicted below for further reference:



Peak demand limiting via the use of gas fired generators is a highly recommended option to further pursue for this development. Space, gas supply and ventilation to this system would also need to be considered.

Micro Co-generation units

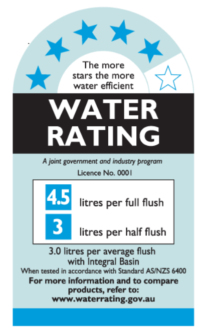
A typical small scale commercial co-generation plant will produce approximately 35 kW of electrical energy and 65 kW of heating energy.

Micro co-generation may be used to combine the functions of space, domestic hot water and pool water heating and on-site electricity generation. Further feasibility study will need to be carried out, at the design development stage, in order to ascertain the most cost efficient configuration of such a micro co-generation system.

5.7 Water Conservation & Management Initiatives

The reduction in the use of water can be achieved in a number of ways. A system for the recycling of rain water will be investigated. These rainwater recycling systems not only need to be able collect the water but also treat and store the water in a suitable manner depending on its intended use. Other measures such as low flow tap ware are other options investigated for the reduction of water use.

<u>Reduction in water usage</u>



Water usage can be reduced with the installation of low flow equipment such as taps and shower heads.

Dual flush toilets significantly reduce water usage and are already compulsory for all new installations. Appliances such as washing machines and dishwashers can use a lot of water. These appliances should be selected based on their high level of water efficiency.

<u>Rain water collection and recycling</u>

Collecting rainwater from roof runoff is a common way to recycle water. In addition to saving drinking water, it allows preparation for times of low rainfall, so gardens can be maintained especially in the water restriction areas. It also reduces loads on storm water systems because roof runoff is not flushed into the drains. Using rainwater will also reduce water bills.

Rain water can be collected from roof runoff and piped to storage tanks.
With treatment to Class A, recycled water can be used on an unrestricted basis for horticulture, irrigation of market gardens and open space recreation, and for garden watering and toilet flushing.

<u>Treatment of collected rain water to Class A</u>

Ultra-violet (UV) treatment is the disinfection process of passing water by a special light source. Immersed in the water in a protective transparent sleeve, the special light source emits UV waves that can inactivate harmful microorganisms. This method of treatment is growing in popularity because it does not require the addition of chemicals.

<u>Treated Stormwater Reuse via Onsite Detention Tank (OSD)</u>

Stormwater reuse can be used for toilet flushing, laundries, water features landscape irrigation, etc. This greatly reduces water consumption for the site.

Depending how well this water can be treated, it will also be worth considering reusing this water to supply the pools. This would not present so much of a health issue if the level of treatment can be guaranteed.

“Grey Water” Reuse

This option uses “grey” waste water (ie. from basins etc.). The water would need to be treated for general irrigation; toilet flushing and laundry reuse purposes.

At this stage the “grey” water would not be recommended for reuse for the pools or other areas where occupants can come into contact with the “grey” water.

Water Loss Reduction

As significant water losses throughout a resort can occur due to evaporation from large pool areas without direct shading or pool covers to reduce night-time losses. We would recommend that these 2 items be considered as part of the final pool solution to minimise water losses.

As heated pools have significantly higher evaporation rates and heat costs associated with them we would recommend against this solution on the basis of the resort ESD target.

Tracking and monitoring (Smart Water Metering)

Smart Water Metering would identify abnormal usage patterns usually associated with leaks, helping to reduce the considerable water lost in this way. In addition, it would allow water efficiency measures to be monitored and tracked for the buildings.

5.8 Environmental Management Initiatives

Energy Sub-Metering

Sub metering to be provided to monitor lighting, mechanical board and general power consumption for the café as well as the Photovoltaic power generation.

Smart metering could be provided for a visual display of the consumption for Electricity, Gas, CO_2 emissions and Water able to be analysed at regular intervals i.e. on a daily / weekly/Monthly /Quarterly and Annual basis.

The visual display should also be able to provide information on the costs associated with this usage, to encourage reduced consumption.

Waste Management System

To encourage and facilitate effective waste management once the development is in operation, sufficient spatial provision should be made to allow for the effective separation of waste from recycling. Dedicated waste recycling rooms allow space for the separation and storage of recyclable waste during the building's operation, allowing for the following waste streams to be separated:

- Glass;
- Cardboard;
- Paper;
- Organics.
- Plastics,
- Metals.

Waste management solutions are varied and dependant on the extent of commitment of the end user. Recycling, reuse and composting are examples of waste management options.

Environmental Management

Effective environmental and waste management should be implemented throughout the demolition, construction and operational stages of this development.
The aforementioned EMP should include a Waste Management Plan, specifying recycling targets for demolition and construction waste. It is recommended that construction and demolition contracts stipulate a minimum 80% target for diversion of waste from landfill. This may be achieved through recycling or reuse.

- Identification of appropriate waste sub-contractors for recycling, costs of collection and timing of collection service;
- Participation in waste minimisation training for contractors and sub-contractors;
- Published waste minimisation plan to reduce site waste to landfill;

Provision of separate waste skips for cardboard, timber, metal, soft plastic, polystyrene, insulation, concrete, glass and bricks.

Learning Resources

This will allow the buildings to act as learning resources by smart metering and providing a visual display of the consumption for Electricity, Gas, CO_2 Emissions and Water. The information can be presented to the public at regular intervals i.e. on a weekly/Monthly /Quarterly and Annual basis.

Maintainability

Permanent maintenance staff to review documentation at preliminary and final design stages in regards to building services and external building features for access, ongoing maintenance and ongoing cleaning.

6 CONCLUSION

A number of ESD options can be implemented at the proposed development at Lewisham development. This report outlines and recommends some of the technically and economically feasible initiatives.

It was recommended to achieve the greenhouse reductions are in an integrated and staged approach:

- First, reduction in overall energy consumption through building fabric optimisations, passive design, demand reduction and energy efficiency, then;
- Reduction in electricity and gas utility consumption by utilising waste products and renewable energy technologies.

Various passive design solutions and sustainability options for the building fabric were discussed including:

- Insulation
- Glazing and Window Framing
- Thermal Comfort
- Natural Ventilation and Air-Change Effectiveness
- Effective Daylighting/ Natural Lighting

Three possible heating, cooling and ventilation system options were compared. It is recommended the water-source packaged unit setup be used as this offers the best compromise between energy efficiency, performance and installation and maintenance costs.

Domestic hot water and pool heating can easily be made more efficient by the use of solar energy. Systems can be implemented which primarily uses solar, using only gas or electricity to meet demand at times of limited availability of solar energy. The effectiveness of the solar system however will be dependent on how much of the roof space can be utilized for the solar collectors.

Grid-connected Photovoltaic system (PV) was recommended as an alternative renewable energy power supply to partially offset the energy load.

Co-generation offers an additional alternative to solar boosted hot water heating with the added benefit of on-site electricity generation. Further feasibility study will need to be carried out, at the design development stage, in order to ascertain the most cost efficient configuration of a central cogeneration system or arrangements for micro co-generation systems.

With the use of water efficient fixtures and equipment within the buildings, it is possible to reduce the use of water. Collection and treatment of rainwater for the use of irrigation and toilet flushing is recommended as this will further reduce the overall amount of mains water that the development uses.

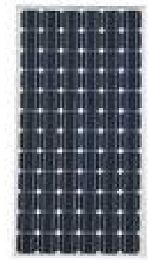
Various environmental management initiatives were discussed including:

- Energy Sub-Metering
- Waste Management System
- Environmental Management
- Learning Resources

The final selection of ESD initiatives will depend on the technical and financial constraints of this project.

APPENDIX A: Photovoltaic Panel Technologies

Mono-crystalline Solar Modules



Mono-crystalline solar modules are the most common example of PV seen around the world. Mono-crystalline solar modules offer the highest commercially available efficiencies (at approximately 17%) meaning that a smaller area of area is required to produce the same amount of electricity. Mono-crystalline solar modules would typically be mounted onto the roof of a building, as they offer little ability to be integrated into a building façade.

Multi-crystalline Solar Modules

Multi crystalline silicon cells are thin wafers of silicon but are cut from multiple crystals grown together in an ingot. They are similar to single crystal cells in life expectancy and fragility. However, they are slightly less efficient than single crystal cells with average efficiencies of around 12% and require more surface area to produce a given amount of electricity. These types of cells are usually square and will have a varied appearance. Multi crystalline cells are cheaper to produce than mono-crystalline cells, due to the simpler manufacturing process.

Amorphous Solar Modules

Amorphous silicon cells are composed of silicon atoms in a thin homogenous layer rather than a crystal structure. Amorphous silicon absorbs light more effectively than crystalline silicon, so the cells can be thinner. For this reason, amorphous silicon is also known as a "thin film" PV technology. Amorphous silicon can be deposited on a wide range of substrates, both rigid and flexible, which makes it ideal for curved surfaces and "fold-away" modules. Amorphous cells are, however, less efficient than crystalline based cells, with typical efficiencies of around 6%, but they are easier and therefore cheaper to produce.

Solar Glass / Glass Laminates

Solar glass or glass laminates use the same technology as mono-crystalline solar cells. The solar glass sandwiches the individual photovoltaic cells between two sheets of glass. This allows light to pass through the spaces between the cells. As the gaps between the cells are increased to allow greater light transmission the efficiency of the modules will drop to approximately 12%. The greater use of glass also leads to an increased cost in modules. Solar glass is best used as a component of the building fabric where it will off-set the cost of a building material.

Schott Solar ASI-THRU

The ASI-THRU solar modules released by Schott Solar use a different form of technology to provide an aesthetic façade system. While silicon is still used, it is not grown into a wafer type cell but is essentially sprayed onto a glass material. As glass forms the structural component of the cell, less silicon is available which reduces efficiency to approximately 6%. The cost of the modules is increased due to the glass component, and as more panels are required to generate the same amount of energy, using ASI-THRU will be more costly. However, ASI-THRU solar modules provide a very good façade replacement, as they allow daylight to entered the space and also allow building occupants to enjoy the view. This type of module would only be considered as a component of the building façade where it can offset the cost of a building material.

Dye-Sensitised Solar Cells

Dye-sensitised solar cells are a relatively new class of low-cost PV. Instead of using silicon to convert the sunlight to electricity they use a photo-sensitised titanium dioxide anode to form a photo electrochemical reaction. The dye-sensitised solar cells are a promising form of renewable energy, as they are made of lost-cost materials (the cost of the bulk material is far less than silicon, from which PV cells are usually made) and are easier to manufacture than the standard silicon cells. The efficiency of the dye-sensitised solar cells is less than the silicon options, at 11%, however these efficiencies are generally not available in commercial quantities. Currently the costs are high per unit of output, however this technology can be considered for application in future.