Commercial and Retail ESD Opportunities

CUNDALL, JOHNSTON AND PARTNERS
CONSULTING ENGINEERS

Contents

Sustainability Statement

The sustainability statement outlined in this document has been established to ensure that the sustainability objectives that have been considered are integrated into the Stockland proposal and delivered throughout the design, construction and on-going management and operation of the development.

The sustainability statement establishes:

1. An overall sustainability policy for the development
2. The desired sustainability performance targets
3. The sustainability initiatives that have been integrated into the design of the Stockland proposal. These initiatives are categorised into:
   - Mandatory requirements: ESD initiatives that will become mandatory for the development. These requirements are identified in the following tables as indicated below.
   - Encouraged initiatives: ESD initiatives which provide a positive environmental contribution but that the developer can only encourage the tenants to adopt. The encouragement can be promoted by providing a greater public awareness of the benefits of the initiatives.
   - Emerging technologies: ESD initiatives that are not commercially feasible at present but will be an emerging technology in Australia in the future. At present these technologies require external funding in order to make feasible. The development team will take the responsibility of assessing these emerging technologies as the project progresses.

Structure of the Sustainability Team

To develop, implement and monitor the objectives and outcomes of this sustainability statement a specialist team with considerable expertise and experience in the application of the principles of sustainable development has been assembled. Each of the following team members have contributed to the achievement of a highly integrated sustainable development.

Development management	-	Stockland
Masterplan Architect	-	Annand Alcock
Landscape	-	Clouston Associates
WSUD	-	Forbes Rigby
ESD	-	CJP
Ecology	-	ERM

Sustainability Policy

The development of the Vincentia District Centre presents a unique opportunity to influence the social, environmental and economic outcomes of the Bay and Basin area. The development will be a truly integrated community with a range of services and facilities to meet its needs. With this comes the responsibility to ensure that the exceptional natural beauty and ecological significance of the area is not compromised.

The vision statement for the project is "to create a high quality, active, integrated and sustainable coastal community whereby its character is informed by the unique bushland setting and undulating topography and where ecological impacts are minimised".

The development will incorporate buildings that are designed for occupant comfort, with the latest technological advances in energy efficiency, stormwater management, water conservation, waste management and material selection. The resources savings demonstrated by the innovative ESD strategies will provide considerable environmental benefits, will provide public awareness and will encourage public ownership of these environmental issues.

Objectives and Targets

The project team has established a set of performance targets to compare the proposed project in Vincentia with a similar typical development. The resource conservation targets established for the project are:

- **Energy conservation:** Develop and optimise the energy systems to minimise fossil derived energy compared with conventional systems
- **Water Conservation:** Reduce the potable water consumption and demand on the sewerage system
- **Materials:** Reduce the PVC usage in materials and promote materials with a low environmental impact and high indoor air quality.
- **Waste management:** Reduce waste in demolition, construction and operation.

% saving in the resource			
	Commercial	**Retail**	**Residential**
Energy	30%	30%	30%
Water	50%	50%	40%
Waste	50%	50%	60%
Materials (PVC reduction)	50%	50%	50%

The % percentage savings indicated above are in comparison to a typical development of the same size.

A Sustainable Community

The following key indicators have been used to provide an overall evaluation of the sustainability of the development;

- Environmental
- Social
- Economic

The key sustainability issues are summarised below:

Environmental

- Protection of known threatened species on site
- Preservation of the habitat of the Jervis Bay leek orchid
- Protection of the SEPP14 wetlands and the pristine waters of Jervis Bay through the use of innovative water sensitive urban design initiatives
- Retention of the significant vegetation in the riparian corridors and of the significant mature trees within the residential streets and lots
- Development of energy efficient buildings throughout residential, commercial and retail that will set a benchmark for Australia.

Social

- Provision of employment opportunities within retail precinct
- Large development allows for diversity of housing style as well as product size
- Retirement living developments providing further diversity of product
- Potential for true integration of residential, retail and civic facilities
- Provision of improved open space and small scale active and passive recreation facilities
- Create a network of cycle ways connecting with extensive existing cycleway network connecting to the beach, shopping centre and existing town
- It is envisaged that a mix of 600 full time, part time and casual jobs would be created by the project

Economic

- Provision of employment within retail precinct
- Employment generation during construction period

ESD Initiatives

The following table details the ESD initiatives considered for the projects. The ESD initiatives have been categorised into:

Mandatory (M): ESD initiatives that will become mandatory for the development. These requirements are identified in the following tables as indicated below.

(M): Mandatory

Encouraged (E): ESD initiatives which provide a positive environmental contribution but that the developer can only encourage the tenants to adopt. The encouragement can be promoted by providing a greater public awareness of the benefits of the initiatives.

(E): Encouraged

Emerging (Em): ESD initiatives that are not commercially feasible at present but will be an emerging technology in Australia in the future. At present these technologies require external funding in order to make feasible. The development team will take the responsibility of assessing these emerging technologies as the project progresses.

(Em): Emerging

Separate tables have been developed for the different building types- residential, commercial and retail.

The following ESD indicators were used to evaluate the environmental performance of the development in energy, water, waste, materials, indoor environmental quality, transport, ecology, community initiative and public awareness and educational initiatives

Commercial ESD initiatives

Indicator	Sector	Initiative	Mandatory (M) Encouraged (E) Emerging (Em)	Requirements/Benefits
Commercial	Energy	Energy consumption target- base building	(M)	✓The base building systems for the commercial development will be designed to achieve a 4 star ABGR rating.
Commercial	Environmental	Environmental star rating	(M)	✓The development is to achieve a minimum 4 Green star rating. This will assess the total environmental performance of the development.
Commercial	Energy	Passive design	(M)	✓The developer shall provide; a response to the following passive design opportunities: ✓Optimum footprint size to promote good natural daylight and natural ventilation • Façade thermal and optical performance relating to orientation will be evaluated • Roof insulation R3, wall insulation R2.5 • As a minimum requirement a thermal computer model of the building will be used to optimise the performance of the passive systems and active systems in accordance with SEDA protocol for building simulation. A façade study will be carried out using the thermal modelling. Options will

Indicator	Sector	Initiative	Mandatory (M) Encouraged (E) Emerging (Em)	Requirements/Benefits
				be evaluated in terms of peak cooling level reduction, annual energy consumption and improvements in comfort for the occupants. • A daylighting model will also be used to determine the daylight levels within the commercial spaces. The offices will be designed to achieve a daylight factor of 2.5% for up to 90% of NLA.
Commercial	Energy/ecology	Lighting	(M)	✓No direct beam of light of the base building system is to be directed beyond the site boundaries or upwards without falling directly on a surface with the explicit purpose of illuminating that surface. This reduces the energy consumed as well as the light pollution
Commercial	Energy	Lighting	(M)	✓The lighting will be designed to achieve a maximum lighting power density of less than 13w/m^2
Commercial	Energy	Air conditioning	(M)	✓The AC system will have to achieve minimum energy efficiency in order to satisfy the star rating. Options such as geothermal, VRV, mixed mode and efficient centralised chiller and boiler plant will be considered. The AC design shall have economy cycle control or designed to achieve mixed mode ventilation.
Commercial	Energy	Energy consumption target- tenant	(E)	✓The benefits of achieving a 4.5 star ABGR tenancy rating will be described to potential tenants and encouraged.

Indicator	Sector	Initiative	Mandatory (M) Encouraged (E) Emerging (Em)	Requirements/Benefits
Commercial	Energy	Lighting	(E)	✓External street lighting will be via solar lighting wherever possible
Water	Commercial	6/3 litre dual flush WC's	(M)	✓Reduction in potable water to achieve the required water conservation target
Water	Commercial	*AAA* rating to all shower heads	(M)	✓Reduction in potable water to achieve the required water conservation target
Water	Commercial	Aerators fitted to hot and cold water taps over basins and sinks	(M)	✓Reduction in potable water to achieve the required water conservation target
Water	Commercial	Rainwater collection from all roofs for irrigation, WC flushing and washdown	(M)	✓Reduction in potable water to achieve the required water conservation target
Water	Commercial	Waterless urinals	(M)	✓Reduction in potable water to achieve the required water conservation target
Water	Commercial	Water efficient landscape selection	(M)	✓Reduce water consumption to achieve the required water conservation target
Water	Commercial	WSUD	(M)	✓Provision of bio retention swales and permeable pedestrian ways around all roads and carpark areas
Waste	Commercial	Waste management	(M)	✓A waste management plan will be provided by the developer. Included within the WMP there will be tenant guide to waste management within the office.

Indicator	Sector	Initiative	Mandatory (M) Encouraged (E) Emerging (Em)	Requirements/Benefits
Water	Commercial	Greywater for cooling tower make-up.	(Em)	✓Reuse of grey water for cooling tower make-up.
Water	Commercial	Car/Boat wash down	(E)	✓Provision of a centralised car/ boat wash down facility using recycled water
Materials	Commercial	Materials matrix	(M)	✓A materials matrix will be developed that provides a framework for the selection of materials based on the environmental performance criteria such as – recycled content of material, embodied energy, effect on indoor air quality.
Materials	Commercial	Indoor air quality	(M)	✓As a minimum natural carpets will be selected, *biopaints* used, and an alternative to PVC cables will be sourced.
Transport	Commercial	Reduced VKT	(M)	✓Adequate facilities for secure cycle storage with shower facilities
Transport	Commercial	Ecology	(E)	✓Provide car parking based on survey demands as opposed to generic guidelines
Transport	Commercial	Reduced VKT	(E)	✓Provide a shuttle bus service at low costs to connect Vincentia with the district centres. Bus should be gas or electrically operated.

Retail ESD initiatives

Indicator	Sector	Initiative	Mandatory (M) Encouraged (E) Emerging (Em)	Requirements/Benefits
Energy	Retail	Energy targets- base building	(M)	✓The base building systems for the retail development will be designed to achieve a 30% reduction in energy compared with a similar traditional development.
Energy	Retail	Energy targets- tenancy	(E)	✓The benefits of achieving a similar percentage energy reduction will be described to potential tenants and encouraged.
Energy	Retail	Passive	(M)	✓Passive design developed to promote: • Good daylighting • Façade selection related to orientation • Mixed mode ventilation to indoor/outdoor mall spaces • Roof insulation of R4 and wall insulation R2.5 • Use of water features to provide localised cooling
Energy	Retail	Standard Renewable energy generation	(E)	✓Generate a minimum of x % of the base building energy consumption via traditional renewable energy sources such as PV panels and wind turbines integrated into the roofs of the buildings generations. Options to include: • PV panels • Wind power

Indicator	Sector	Initiative	Mandatory (M) Encouraged (E) Emerging (Em)	Requirements/Benefits
Energy	Retail	Emerging renewable energy generation	(Em)	✓Generate a minimum of % of the base building energy consumption via emerging renewable energy sources • Combined PV/solar heating • Solar thermal energy
Energy	Retail	Solar powered street lighting	(M)	✓50% of car park lighting to be via renewable energy.
Water	Retail	6/3 litre dual flush WC's	(M)	✓Reduction in potable water to achieve the required water conservation target
Water	Retail	*AAA* rating to all shower heads	(M)	✓Reduction in potable water to achieve the required water conservation target
Water	Retail	Aerators fitted to hot and cold water taps over basins and sinks	(M)	✓Reduction in potable water to achieve the required water conservation target
Water	Retail	Rainwater collection from all roofs for irrigation, WC flushing and washdown	(M)	✓Reduction in potable water to achieve the required water conservation target
Water	Retail	Waterless urinals	(M)	✓Reduction in potable water to achieve the required water conservation target

Indicator	Sector	Initiative	Mandatory (M) Encouraged (E) Emerging (Em)	Requirements/Benefits
Water	Retail	Water efficient landscape selection throughout all gardens	(M)	✓Reduce water consumption to achieve the required water conservation target
Water	Retail	WSUD	(M)	✓Provision of bio retention swales/permeable surfaces around roads and carpark areas
Water	Retail	Greywater for cooling tower make-up.	(Em)	✓Reuse of grey water for cooling tower make-up.
Waste	Retail	Organic waste recycling	(E)	✓The organic waste from the food outlets can be recycled and collected by SEDA
Waste	Retail	Waste management	(M)	✓A waste management plan will be provided by the developer. Included with this WMP there will be tenant guide to waste management within the office.
Materials	Retail	Materials matrix	(M)	✓A materials matrix will be developed that provides a framework for the selection of materials based on the environmental performance criteria such as – recycled content of material, embodied energy, effect on indoor air quality.
Transport	Retail	Reduced VKT	(M)	✓Adequate facilities for secure cycle storage with shower facilities
Transport	Retail	Ecology	(E)	✓Provide car parking based on survey demands as opposed to generic guidelines

Indicator	Sector	Initiative	Mandatory (M) Encouraged (E) Emerging (Em)	Requirements/Benefits
Transport	Retail	Reduced VKT	(E)	✓Provide a shuttle bus service at low costs to connect Vincentia with the district centres. Bus should be gas or electrically operated.

A Benchmark: The proposed development in Vincentia has challenged the conventional and emerging guidelines for sustainable developments in Australia. The focus has been in the delivery of a development that will become a benchmark over the next 10years in sustainable living and working. The objective of this report is to outline the sustainability initiatives that have been considered and that have been integrated into the Stockland proposal. A separate report has been prepared for the residential component of the project.

The Vision: The development will incorporate the latest technological advances in energy efficiency, stormwater management, water conservation, waste management, material selection, and occupancy comfort. The retail and commercial component of the development represent a unique opportunity to benchmark a number of ESD initiatives that, as well as providing energy/ environmental savings, will provide a public awareness and will encourage public ownership and knowledge of the environmental issues. Some emerging renewable energy technologies have been considered that can integrate roof systems with power generation, hot water generation, water recycling whilst providing daylight to the spaces below.

A sustainable retail environment: There are now established ESD guidelines that have been legislated for residential and commercial developments in terms of minimum performance requirements with retail and leisure facilities being on the agenda next. The successful integration of ESD strategies in retail buildings has to be based on a practical understanding of the operational costs of a retail centre. The base building costs of cleaning, maintenance and repairs can represent up to 50% of the total operational costs whereas the energy bills might only represent up to 5% of the operational costs. Lighting of the centre can be up to 60% of these energy costs and the actual costs of maintaining the AC can be the same as the actual annual running costs of the AC system. Reducing the energy used in the building by 50% could save up to $40,000 per year whereas halving the maintenance costs save $70,000 per year. The focus has therefore been in developing ESD strategies that provide an overall lifecycle benefit to the building operator, tenant, as well as the people that work and shop at the centre.

One of the solutions that would provide considerable value to shoppers and retail operators would be in the development of the passive systems in spaces that have high levels of daylight and natural air movement with low maintenance and running costs whilst providing the shoppers with an improved internal environment.

Introduction

Vincentia is a new community development incorporating approximately 600 mixed residential dwellings and a district centre. The District Centre is to be located adjacent to the crossroads of the Wool Road and Naval College Road, and will initially have around 21,000m² of retail and commercial floorspace, with eventually up to 32,000m²of development. .

CJP have been appointed to promote and develop Ecologically Sustainable Development (ESD) strategies throughout the design stages of the project in Vincentia.

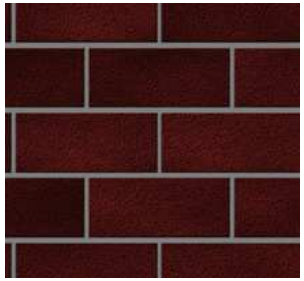
The vision statement for the project is:
"to create a high quality, active, integrated and sustainable coastal community" whereby its character is informed by the unique bushland setting and undulating topography; and where ecological impacts are minimised.

This vision will be realised with the successful integration of the ESD strategies that incorporate the latest technological advances in energy efficiency, stormwater management, water conservation, waste management, and occupancy comfort. The resource savings demonstrated by the innovative ESD strategies will provide considerable environmental savings, will provide public awareness and will encourage public ownership of these environmental issues.

This report addresses the ESD issues for the commercial and retail component of the development.

Methodology



The following ESD indicators were used to evaluate the potential environmental performance of the development:

- Energy
- Water
- Waste
- Materials
- Transport

Throughout, our philosophy has been to identify the opportunities to reduce the need for each resource, then look options to reuse the resource or obtain that resource from renewable source

Each section of the report has been set out with the following headings for each environmental consideration:

- **Background** – The context in which that resource is used
- **Objective** – the key objectives in using that resource in a more sustainable way
- **Options** – descriptions of the products available and their considerations
- **Performance** – How those products fit into the Vincentia development

Demonstrating the environmental savings of the development is best done using easily identifiable quantities that anyone can picture. These are;

- Energy use – The average family-sized car pumps out around 4 Tonnes of CO2 into the atmosphere every year. This is equivalent to the pollution created by a coal burning power station generating 4,250kWh of electricity. 1kWh of energy used is the equivalent of leaving a room convection heater on for an hour.
- Water Use – An Olympic swimming pool holds around 10,00kL of water
- Waste Generation – Wheelie bins hold a relatively small amount of waste so development-wide savings gives too big a number for people to really picture. Instead, the small, car-sized skip that holds 3.5 Tonnes of waste has been used.

How can you measure environmental performance?

There are a number of tools that are available in Australia to measure the environmental performance of a proposed development as well as a number of overseas environmental rating tools such as LEED from the US and BREEAM from the UK, that can be used as a comparison. The two main commercial star rating systems used in Australia are:

ABGR star rating systems (DEUS)
The Australian Building Greenhouse Rating scheme equates the predicted energy consumption of a commercial building into a star rating. 1 star is very poor energy efficiency with 5 stars being excellent energy efficiency. A 3.5 star building would be current market best practice.

The ABGR star rating system has been in use for 3 years in NSW and is now starting to form part of the DA requirement for a majority of urban development i.e. most major developments in the CBD are required to achieve a 4.5 star rating.

BUILDING GREENHOUSE RATING

green star
environmental leadership for buildings

The Green Star rating system
The ABGR star rating relates only to the energy consumption of a building whereas the Green Star relates to a broader criteria of environmental performance which includes:

- water conservation
- energy conservation
- waste management
- material selection
- indoor air quality

The Green Star rating system has only recently been introduced with the first projects going through the official accreditation process.

At present there are no official energy or environmental rating systems for retail developments.

How is the Green Star weighted between categories?

A rating tool that provides a single score must take some assumption regarding the relative importance or environmental impact of different building features. The Green Star system uses the framework adopted by the UK's BREEAM (Building Research Establishment Environment Assessment Method) system as follows:

- Each credit category (i.e. Energy and indoor environmental quality) has an environmental weighting; and
- The number of credits allocated to each issue (e.g. daylighting and noise for indoor environmental quality category) is effectively weighted between issues within a credit category.

The weightings have been derived by considering a variety of scientific and stakeholder opinion. The table below compares the respective weighting for commercial office buildings:

	LEED (the US system)	BREEAM (the UK based system)	***Green Star* The Australian based system)**
Management	7%	15%	10%
Indoor environmental quality	22%	15%	20%
Energy	24%	12.5%	**25%**
Transport	6%	12.5%	10%
Water	7%	5%	**12%**
Materials	16%	10%	10%
Ecology	13%	15%	8%
Emissions	5%	15%	5%

How can we achieve a high environmental star rating for the Vincentia development

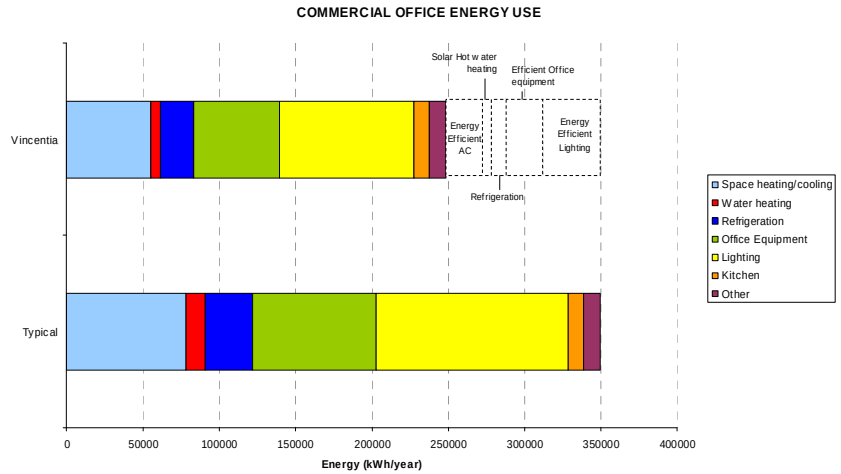
There are no official guidelines for both the ABGR *(DEUS)* and Green Star rating system on how to achieve high ratings.

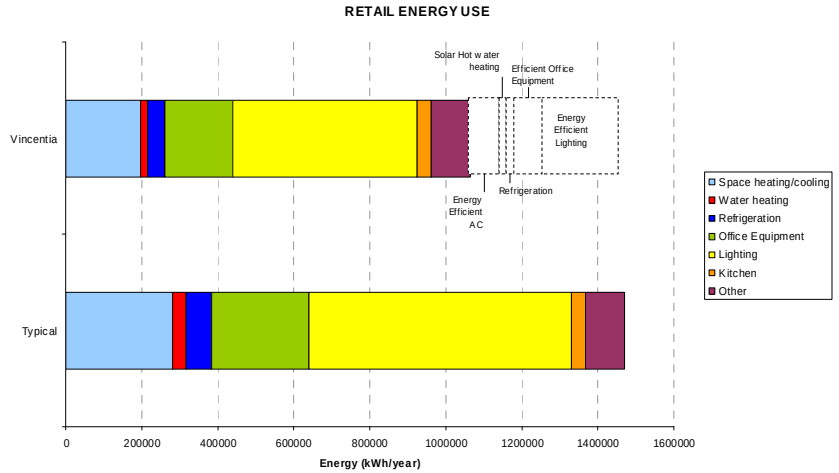
The table below outlines a number of the possible options:

ABGR star rating *(DEUS)*	**Green star ratings**
✓ developed of energy efficient facades using external shading/low 'e' glass ✓ use of energy efficient AC with consideration of geothermal, chilled ceiling technology, cogeneration, underfloor AC ✓ energy efficient lighting and controls with consideration of TS lighting and daylight interface control/dimming ✓ use of energy efficient lifts ✓ natural ventilation of car park spaces	✓ a high ABGR star rating (4.5 stars and above ✓ design of building facades to encourage improved daylight ✓ high levels of indoor air quality through the use of natural ventilation, underfloor AC etc ✓ water conservation – recycling of roof, water, consideration of grey and black water treatment and re use ✓ integration of renewable energy schemes with new technologies or the innovative application of existing technologies ✓ reduction in the use of PVC

Objective

A target has been set to achieve a minimum 4 star ABGR energy rating and a 4 Green Star rating. Incentives could be made to encourage these minimum targets to be exceeded.





Background

A typical retail and commercial development of this size will consume the following energy annually:

	Office	Retail
Space heating and cooling	23%	19%
Water heating	4%	3%
Office Equipment	22%	16%
Refrigeration	9%	5%
Lighting	36%	47%
Other	6%	10%

For an average usage pattern approximately 350,000kWh of energy would be used in a standard office development of this size and 1,470,000kWh for an equivalent sized retail mall. Overall, this is equal in CO_2 emissions to 428 cars.

To achieve an ABGR star rating of 4 stars instead of the NSW average of 3 stars requires a 30% reduction in energy use and greenhouse gas emissions.

Objective

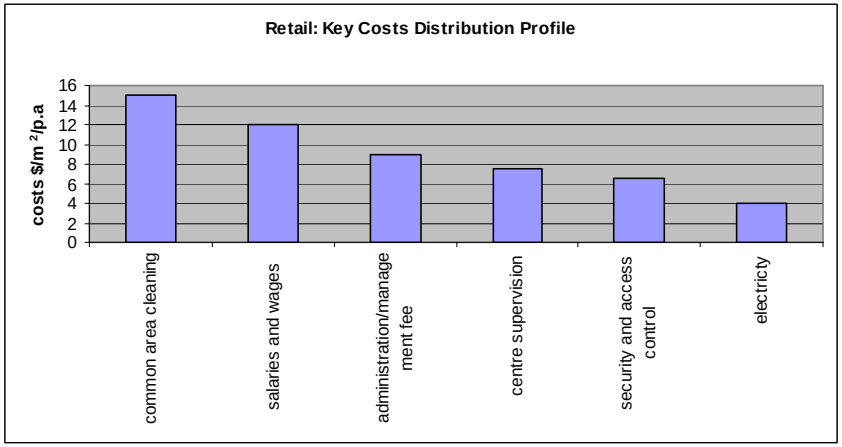
The objective established for the project is to reduce the energy consumption of the base building system by 30%

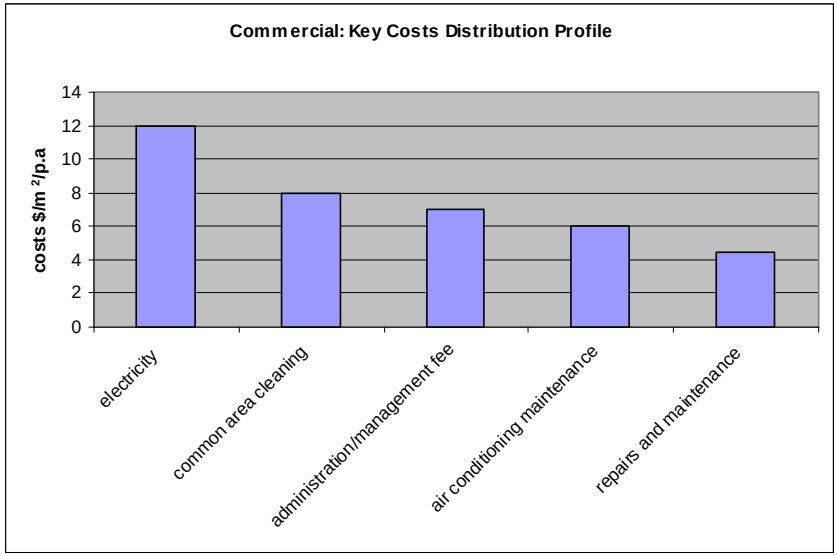
Overall Operating Costs

The graphs opposite indicate the approximate overall operational costs for a retail and commercial development similar to the one proposed at Vincentia.

The key points are:

1. Operational cost of a retail centre can represent up to 80% of the total costs. Statutory costs for water rates, municipal rates and land tax represent the other 20%.
2. Common area cleaning for retail is one of the highest annual costs and can be four times the cost of cooling and lighting the space.
3. The cost of maintaining the AC plant can be more than the actual cost of running the plant.
4. For commercial buildings the main costs are the energy bills.





Passive Design

The objective of good passive design for buildings is to optimise the passive features of the building initially and then select the most appropriate artificial solution for heating, cooling and lighting if required. The overall result is to develop a building that is more comfortable for the occupants whilst consuming a minimum amount of energy.

- orientation
- shading
- natural ventilation (mixed mode)
- daylighting
- insulation and thermal mass

A new Sainsburys supermarket in the UK that uses 50% less energy than a typical supermarket

Orientation

The orientation of the buildings can often be influenced by site constraints. A preferred orientation in terms of occupant comfort and energy efficiency is to reduce the area of glass to the east and west facades with the larger facades of the building facing north-south. Even with the preferred orientation the shading systems for the building now need to be developed

Shading

Considerable energy savings are only achieved for the preferred orientation if the north facing glass has horizontal shading to minimise the solar intensity in the summer months. Ideally the horizontal shades should eliminate all midday sun between November to March. Shading is also required to west facing glass to shade the low afternoon sun angles. The development of the thermal and optical properties of the glass need to be evaluated alongside the design of the external shading.

Optimum footprint size for natural ventilation and good daylight

The optimum footprint size that provides excellent daylight levels whilst still providing the option of cross ventilation is approximately 10-14m.

A project such as the Vincentia project should be able to achieve this providing the occupants of the commercial spaces with excellent access to natural daylight and ventilation without overheating or glare issues.

Performance

Using good passive design could save energy use by around 10% in reducing the need for lighting and air conditioning

Total Commercial/Retail Energy Saving	10%
Payback Period	Instant
Total Greenhouse Gas Avoided over whole commercial/ retail development (No of cars taken off the road)	42 Cars

Lighting

The development of an optimum footprint size to promote excellent levels of natural daylight will provide considerable energy savings and improvements in comfort. Due to artificial lighting being a major contributor to energy consumption particularly for the retail areas then energy efficient lighting will be required throughout.

The main criteria for assessing artificial lighting are;

- lamp life
- lumen depreciation
- efficiency (lumens/watt)
- range of colour temperatures
- cost
- availability
- losses
- type of control gear

An important point to note is that because of the increased light intensity, the quality of the louvre is important. The ideal solution is to utilise indirect lighting and illuminate the space by reflecting from building surfaces. The lighting should be designed to provide a lighting power density of approximately 10W/m^2, saving around 30% of the lighting energy of a standard solution.

For commercial offices the optimum solutions for lighting usually comes down to a choice between T5 and T8 light fittings. The considerations of both lamps are summarised in the table:

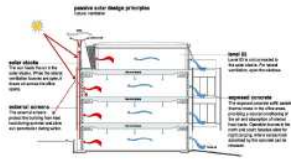
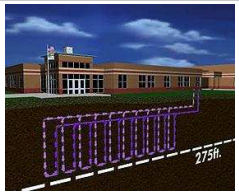
Item	**T8 (triphosphor high frequency)**	**T5 28W**
Circuit watts	36	32
Initial lumens @ 28degC	3350	2600
Lamp lumen maintenance factor (8000hrs)	0.96	0.97
Overall maintenance factor (1 year)	0.76	0.85
Colour temperature	2,700 to 4,000k	2,700 to 4,000k
Colour rendering index	80-90	80-90
Dimmable	Yes	Yes
Glare	Moderate	High (depending on luminaire)
Cost	$3.50	$5.00
Control gear	Iron core or electronic	Electronic or digital

Total Commercial/Retail Energy Saving	13%
Payback Period	<6 months
Total Greenhouse Gas Avoided over whole commercial/ retail development (No of cars taken off the road)	56 Cars

Energy Efficient AC

The air conditioning of a commercial building can account for up to 40% of the total energy consumption so an energy efficient AC is therefore key to the development of a low energy building.

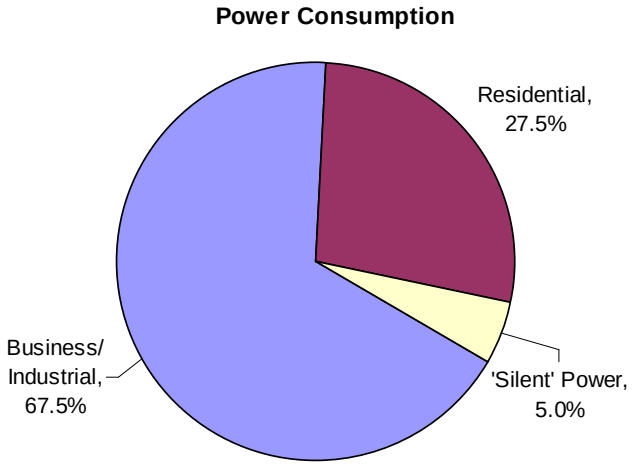
A number of energy efficient AC options can be considered after the passive performance of the building has been optimised. These options would include;

	Natural Ventilation	Hybrid or Mixed Mode	Geothermal Mixed-Mode	Chilled ceiling technologies
				
Considerations	No AC is provided and the building merely floats with the outside temperature. Some heating will be required, but is reduced by good passive design.	A simple AC system is provided to reduce temperatures when its too hot outside.	The AC system efficiency can be enhanced by using the earth as a heat store/sink. Because it is at a constant 18°C it is cooler in summer and hotter in winter than the ambient air.	Chilled beams and ceilings are more efficient than air based AC systems. The chiller doesn't work as hard and large quantities of air don't have to be moved around the building. However, a mixed-mode system cannot be utilised - the building has to be sealed to control humidity.
Total Commercial/Retail Energy Saving	17%	8.5%	15%	8.5%
Payback Period	Instant	< 5 years	5-7 years	5-10 years
Total Greenhouse Gas Avoided (No of cars taken off the road)	73 Cars	36 Cars	64 Cars	36 Cars

Renewable energy

Background

Australia's on-grid electricity generators can produce some 46,000 MW of power. The pie chart below is based on maximum capacities and indicators that up to 60% of energy is still provided by coal fired power stations. The pie chart on the right indicates the percentage split of power consumed between commercial/industrial and residential. Remarkably up to 5% of our total power consumed is by devices left in standby mode (silent power). Australia has a mandatory renewable energy target of 9500GWh/year by 2010 with a penalty of $40/MWh for not compliance.



Objectives

An objective would be to generate greater than 10% of the energy consumed by the base building systems via renewable energy. This can be achieved with the integration of new technologies or the innovative application of existing technologies – or a combination of the two.

The Green Star environmental rating tool recognises schemes that generate 1% or more of the base building energy consumption via renewable energy schemes.

Options

The following options have been considered in detail.

Option 1 – Wind energy	*Option 2 – Solar energy*	*Option 3 – Combined Heat And Power Systems*	*Option 4 Solar thermal*
The use of vertical axis wind turbines that generate green energy at low wind speeds with no noise issues.	Use of PV panels (photovoltaic panels) to generate green power. The panels can either be integrated into the roof structure or the facades of the building.	This is a technology developed by ANU Canberra which is a combined solar electric and solar hot water system (CHAPS).	Solar thermal is a technology that uses parabolic reflectors to concentrate the suns rays on to a heat pipe in the centre of the unit. This high temperature fluid can then be used to drive a generator to produce electricity.

Wind Energy

Description

Innovations in wind energy have recently been in the application of the turbines into the urban built environment and how to minimise noise and other environmental issues.

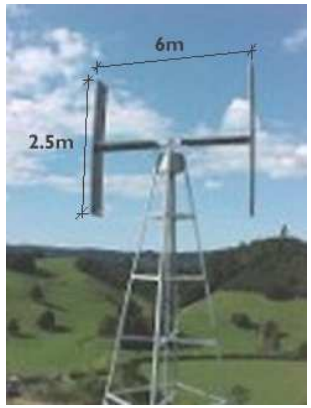
Considerations

The available wind data for the site will need to be determined in order to provide an accurate evaluation of the potential green power that can be generated by the wind turbines.

The selection of the wind turbine will follow this process;

- determine the annual wind speeds and direction
- determine the possible location of the wind turbines (exposed part of the site or on the roofs of the commercial).

There are two main wind turbine technologies;

Horizontal Wind Turbines	**Vertical Wind Turbines**
	
The horizontal wind turbines are a cost effective solution but have the disadvantage of generating high noise levels. The turbines generally require a wind speed of approximately 5m/s to generate electricity.	The vertical axis wind turbines are quieter and can generate power on lower wind speeds of greater than 1.5m/s

Innovative Application

The wind turbines could be integrated into the roof of the building to generate green power 24 hours a day

Solar Energy

Photovoltaic panels (PV panels) produce power by converting the suns energy into electricity. The technology of the traditional PV panels has not advanced considerably over the last 10 years so therefore the efficiency of the panels have not improved. The main innovations in the technology have been in the integration of the panels into roof structures and façade system.

PV can be used effectively as solar shading

It can replace roofing material

This warehouse in California produces lots of electricity from PV panels

Considerations

The cost of the PV are still expensive making the payback periods long. Government grants become available periodically to assist in the funding of such schemes.

Innovative applications

The innovative application of PV panels would be:

- the use of PV panels on north facades to provide shading as well as generating energy
- the use of PV panels integrated into the facade of buildings
- the use of PV panels as roof cladding of external areas that require shading.

Combined Solar And Power System (CHAPS)

Description

The combined heat and power system is a solar concentrator system suitable for generating both electricity and hot water. A parabolic mirror tracks the sun on a single axis and reflects light onto a strip of high efficiency solar cells at about 35 times the normal intensity. The solar cell converts about 20% of the sunlight into electricity. The balance of solar energy is converted into heat which is removed by water flowing in a channel behind the solar cells. This technology has been developed by the ANU in Canberra.

		
A test rig of the CHAPS system in Canberra	The CHAPS system at ANU. The protective coating on the mirrors is still in place and the PV section needs to be added.	The system installed on top of the residential block.

Considerations

The CHAPS system is technically well advanced but the commercial production of the units are still in their infancy. The CHAP system would require slightly more maintenance and commissioning than conventional PV panels due to the solar tracking system.

Innovative applications

The CHAP collectors are suitable for mounting on roofs of building in close location to the central plant.

Solar Thermal Energy

Description

The solar thermal energy systems uses a similar concentration principle to the CHAPS system by concentrating the suns rays on a central heat pipe. The fluid in the pipe heats up to high temperatures which can be used for heating, or processed through an absorption chiller for cooling, or used in a steam process for generating electricity.

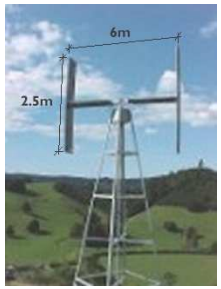
The solar thermal system can be integrated into the roof design of atriums as a combined energy scheme and daylight scheme.

		
The 'Power Roof' system is different to the CHAPS system in that the pipe moves to track the sun rather than the reflector moving	The reflectors can be arranged to allow diffuse sunlight through behind them	This gives a well lit atrium that is shaded from direct sunlight.

Considerations

The solar thermal energy system that can be integrated into roof system to provide natural daylight as well will be commercially available in February 2005. A test system is currently being installed in Sydney and will be completed in December 2004.

Renewable Energy Performance

	Option 1 **Wind Energy**	**Option 2** **PV Panels**	**Option 3** **Combined heat and power system**	**Option 4** **Solar Thermal**
				
Size of unit to generate 10% of energy [80,000 kWh/yr]	4No. 30KW turbines	400 panels, 400m^2 of roof area	400m^2 of collector producing electricity and hot water	500m^2 of collector producing steam
Capital cost to generate 10% of load	$500,000	$650,000	$1,000,000	$1,200,000
Running cost savings	$8,000	$8,000	$6,400 (electricity), $5,025 (hot water)	$10,700 (electricity), $5,000 (hot water)
Total Commercial/Retail Energy Saving	6%	6%	9%	11%
Payback Period	63 years	82 years	88 years	72 years
Total Greenhouse Gas Avoided (No of cars taken off the road)	20 Cars	20 Cars	30 Cars	37 Cars

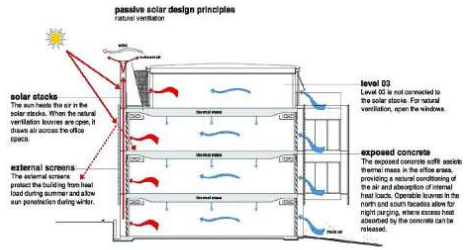
The figures above have been calculated to generate 10% of the base building electrical load via renewable energy for the commercial and retail areas. In total the commercial and retail base building systems will consume approximate 800,000kwh/year (44% of the total energy use).

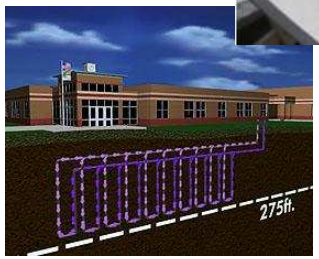
Energy Reduction - Recommendations

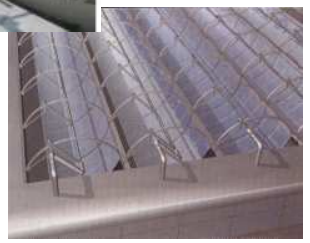
Mandatory

The commercial development should aim for a ABGR star rating of at least 4 stars. The retail development should aim for 30% less energy consumption than a typical shopping mall. These targets will be achieved with;

- Good passive design – Orientation, shading, insulation, dedicated natural ventilation and thermal mass all help to reduce energy consumption by around 10%
- Energy efficient lighting throughout the development – will reduce energy use by 13% with little or no additional cost
- Solar generated hot water – A simple system would save around 3% of annual energy.
- Efficient mixed-mode AC systems – making the office spaces naturally ventilated for the majority of the year with AC for extreme conditions will reduce energy use by 8.5%







Encouraged

- The benefits of tenants achieving a similar ABGR tenant energy star rating as the base building will be encouraged.
- Using geothermal heat pumps for the AC system will further reduce energy consumption by 6.5%
- Installing a 'power roof' system will save 11% of energy use by producing electricity and hot water simultaneously (this replaces the 3% saving with solar generated hot water as that system would not be needed). It is an innovative system and serves the dual purpose of replacing the roofing system over the retail atrium, possibly reducing payback time.

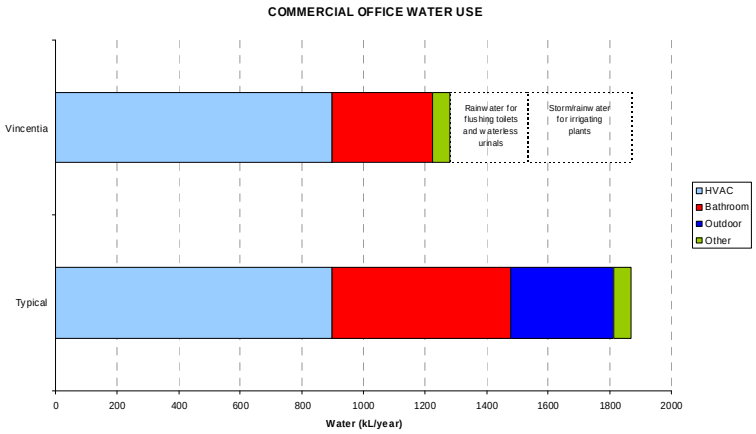
Emerging technology

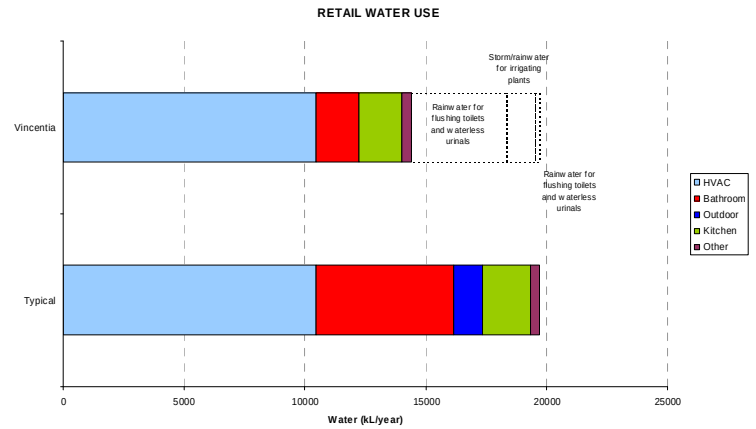
- Emerging renewable energy systems such as *solar thermal* systems or combined PV and solar hot water panels can offer an alternative to traditional renewable energy sources. Usually there are additional driver such as green marketing, government grants or infrastructure demands. In this instance there are no drivers at this moment and so these systems have long paybacks.

Performance

Including the definite features described above will give savings of up to 35% with a further 15% savings available for items under consideration

Total Commercial/Retail Energy Saving	35%
Payback Period	< 5 years
Total Greenhouse Gas Avoided over whole commercial/ retail development (No of cars taken off the road)	150 Cars





Background

Water is a precious and high demand resource and reducing consumption is a critical part of alleviating pressure on sources and maintaining water availability. The key issues relating to water are:

- Reduction of water usage through efficient appliances
- Reclaiming water that would otherwise be lost - Rainwater
- Reuse of water - Greywater
- Recycling of water on-site prior to release - Blackwater

Residential and commercial/retail buildings use similar amounts of water but in very different ways.

	Office	Retail
HVAC	46%	53%
Bathroom	31%	29%
Outdoor	18%	6%
Kitchen	2%	10%
Other	3%	2%

For Vincentia the amount of water used in the commercial and retail development would use around 37,500kL of water each year or the equivalent of 37 Olympic sized swimming pools per year.

Reducing water use in the HVAC equipment, i.e. Rainwater top-up for cooling towers, will save the most water, followed by water efficient fittings like toilets, urinals, taps etc.

Objectives

Water use can be reduced through efficient fittings and appliances. Also, potable water use can be reduced by collecting rainwater or reusing water (greywater and blackwater).

For Vincentia the target is 50% water reduction. This will save around 18,750kL of water per year, the equivalent of 18 Olympic swimming pools. Reducing the impact on the sewer should also be considered but this will only be possible by reusing or recycling water.

AAA Fittings

The best way to be water efficient is to reduce water use in the first place.
AAA rated fittings are available for the showerhead and taps. They generally reduce flow by 50% but aerate the water to give the impression of standard flow.
AAA rated toilets have 3/6L dual flush cisterns with an average flush of around 4L in comparison to the standard 11L cistern of 15 years ago.

These fittings have become standard fit in most new-build instances with little or no additional cost and considerable savings in the bathroom.

Savings are less apparent in any kitchen/cleaning areas. This is because generally speaking things are filled in the kitchen (kettles, jugs, buckets, the sink etc.) so it doesn't matter the rate at which they are filled. If people are rinsing things under running water, such as mugs or plates, then using AAA fittings will save water.

Sensor systems have become popular within commercial bathrooms. The tap senses hand movement and allows flow for a short period of time, reducing water use and risk of flooding. The taps can be mains powered, battery-powered or, in the case of one American company, hydro powered with a small impellor in the tap charging a small rechargeable battery every time the tap is used.

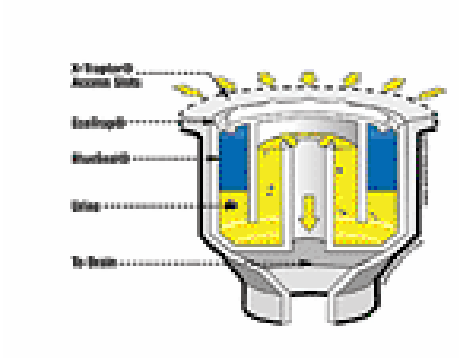
Waterless Urinals

A wall hung urinal without a water inlet connection. The water seal between the urinal and the waste pipe is substituted with a sealed cartridge that has an oil seal built into the waterless urinal trap. The oil seal effectively prevents odours entering the bathroom.

Benefits of the Waterless Urinal
Each waterless urinal stall will save approximately 65,000 litres per urinal annually and the complete installation is less complex due to the elimination of pipework and flushing devices.

Considerations
The main issues with waterless urinals are

- tenants perception of waterless urinal i.e. people think that flushing water is always required
- a different maintenance strategy is required to top up the seal every 7,000 – 10,000 uses
- the capital cost of the urinals are approximately $1,200 each. However, there is a cost saving on the installation of water supply pipework and a conventional urinal system would still cost around twice the cost of a water less system.



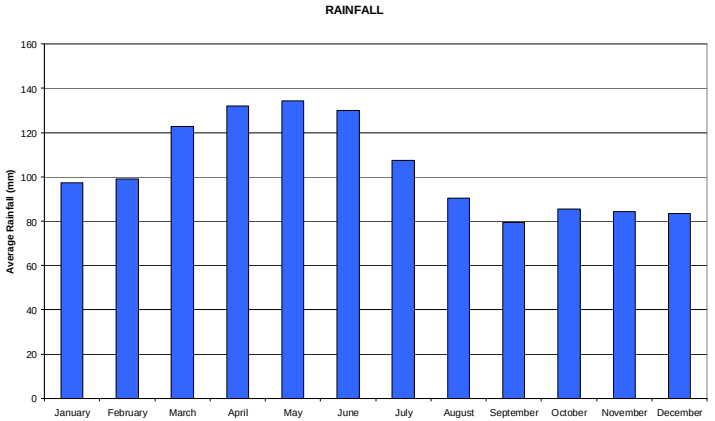
Performance

Installing AAA fittings and waterless urinals throughout the buildings will save 40% of the water use in the bathroom. There would be little or no additional cost, even retrofitting appliances takes less than a year to payback.

Total Commercial/Retail Water Saving	13%
Payback Period	<6 months
Total Water saved over whole commercial/retail development (no of olympic-sized pools filled per year)	4 Pools

Rainwater Tanks

In Sydney, the average annual rainfall is 1000L/m^2. The office and retail areas will have a combined roof area of around 15,000m^2 so this means that 15,000kL of water should be available for collection. However, after a dry period the roof must be flushed of debris and the roof will always absorb some water. Also, in times of heavy rain there won't be enough storage so some water will overflow straight to storm drains. For a roof of this size a tank of around 415kL should be provided. 1kL is equal to 1m^3 in volume, so the tank would need to be about 15mx10m x 3m(high)



Rainwater is relatively clean and free of any harmful bacteria. NSW health allows rainwater to be consumed but recommends grid water if available. Rainwater can be safely used for most activities including flushing toilets, watering landscape and washing cars without any treatment other than basic solids filtration, replacing a large portion of potable water use. It is also suitable for HVAC cooling top-up. For any of these uses, it would be worthwhile fitting a mains top-up to ensure there is always a small amount of water in the tank during a dry-spell.

Trafficable systems are also available for installation under the car parks/driveways if space is limited, these cost around $15,000 for a 15,000L tank

Performance

Assuming around 15,000m^2 of roof area with 415kL rainwater tank 15,000kL per year or 40% of the base water use. A system with mains top-up would cost up to $150,000 with a 10 year payback in water savings.

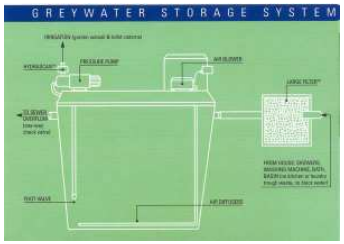
Total Commercial/Retail Water Saving	40%
Payback Period	10 years
Total Water saved over whole commercial/retail development (no of Olympic-sized pools filled per year)	15 Pools

Greywater Systems

Greywater is water that has been used before but has not passed through humans, therefore it is relatively low in harmful pathogens. The advantage of using greywater over rainwater collection is that not only does it reduce potable water use, it also reduces the load on municipal sewerage facilities, allowing more buildings in an area with no increase on infrastructure demand. Payback on greywater systems can be deceptive because it doesn't include the saving in waste water – but in the future we may be charged for our waste, halving the payback period.
However, NSW Health have strict controls for greywater reuse:

- Greywater from a washing machine can be diverted to sub-surface irrigation pipework under landscaping. It must be manually switched (or pumped from a surge tank < 100L) when required and cannot be used during rainy periods. Root vegetables that will be eaten raw must not be irrigated with greywater. Nitrates in laundry powder can promote weed growth, natural detergents are available that do not include these additives and should be used.
- If greywater is to be used for flushing toilets or spray irrigation, or any purpose in which it may come in contact with humans, then it must be treated to a secondary level through the use of reed beds or an Aerated Waste Treatment System – the same system used for full sewerage treatment. However, on a commercial development the economies of scale can make it more cost effective.

Victoria has a more relaxed treatment requirement. A number of manufacturers there produce units that use greywater to flush toilet cisterns as well as providing sub-surface irrigation, saving up to 30% of the annual water use with a slightly reduced payback.



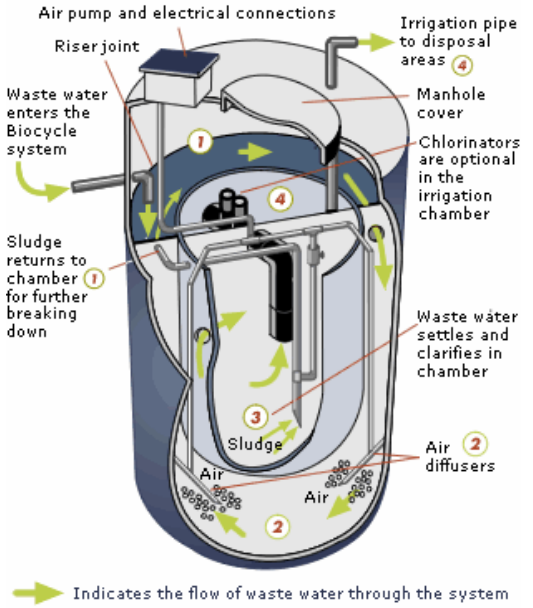
Performance

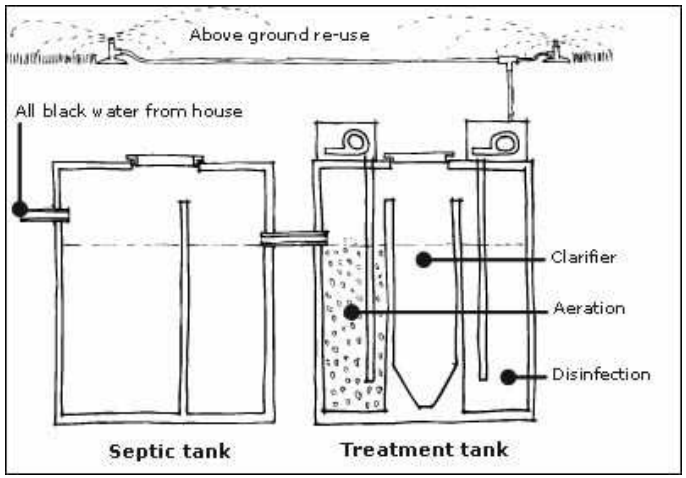
Installing an AWTS system for all greywater (water from hand basins), costs around $125,000 and provides recycled water for flushing the toilets.

Total Commercial/Retail Water Saving	15%
Payback Period	24 years
Total Water saved over whole commercial/retail development (no of Olympic-sized pools filled per year)	5 Pools

Blackwater Systems

Blackwater is water that has passed through humans or has been used in cooking so it is high in harmful pathogens and suspended solids.
The only way to treat blackwater is to put it through a full Aerated Waste Treatment System (AWTS) that separates out the solids and filters the water back to a clear odourless liquid suitable only for irrigating landscapes.
Although 100% of commercial water use can be recycled, unfortunately only 15% of potable water is required for irrigation meaning 80% has to be dumped to either the sewer (wasted energy as it will be treated twice) or dumped to stormwater drains which is not acceptable to NSW Health.
Regular cleaning and maintenance also has to be considered.
This means that blackwater systems are only really applicable for isolated locations where there is a huge area of ground to irrigate and no stormwater drains to pollute.
Also, Shoalhaven has recently installed a large-scale municipal blackwater recycling system so there is little incentive to recycle water on-site at each dwelling.





Performance

Installing a municipal AWTS system (equivalent to 100 homes) would cost around $630,000 and save 15% potable water use in irrigating the landscape.

Total Commercial/Retail Water Saving	15%
Payback Period	120 years
Total Water saved over whole commercial/retail development (no of olympic-sized pools filled per year)	5 Pools

Water Use - Recommendations

Mandatory

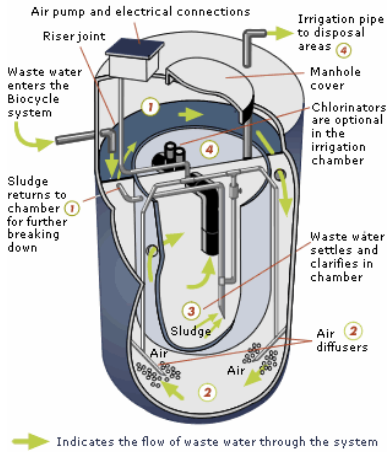
- AAA fittings and Dual-Flush toilets have become industry standard and have little extra cost. Waterless urinals and sensor taps also save water and should be included. Overall, these fittings will save 13% of the annual water use.
- Rainwater Tanks collect vast amounts of water that would otherwise be lost to the drains. The water requires little treatment and there is no ongoing plant maintenance. Rainwater tanks can provide up to 40% of water use.

Encouraged .

- Waterless urinals will be encouraged throughout the commercial and retail areas.

Emerging technologies

- Greywater could be used to flush toilets as well as watering the landscape saving up to 15% of water use. NSW Health recommend using an AWTS (blackwater system) for this purpose which could provide water for flushing toilets and watering landscape. Combined with the use of rainwater for topping up HVAC plant and wash hand basins, the potable water use could be reduced by up to 70%.
- Similarly, on-site full blackwater treatment is expensive and saves only a relatively small amount of potable water for the environmental risk involved in not maintaining the plant sufficiently.



Performance

Including the definite features described above will give savings of up to 53% with a further 15% savings available for items under consideration

Total Commercial/Retail Water Saving	53%
Payback Period	10 years
Total Water saved over whole commercial/retail development (no of olympic-sized pools filled per year)	19 Pools

Background

A typical development of this size would produce about 1500 tonnes of mixed waste per year, this equates to around 428 skips of rubbish going to landfill annually.
Typically this amount of waste is made up of:

- 15% Organics
- 39% Cardboard
- 7% Paper
- 5% Other Recyclables (Plastics, Glass, Metal)
- 35% Other

The majority of the recyclable component can easily be collected by providing sorting bins within the development and including a dedicated bin in all offices/retail units. Some recycling of paper and cardboard already takes place but if all cardboard and paper can be recycled then 46% of waste would be saved from landfill .

At present, the organic component (from commercial kitchens and supermarkets) would most likely go straight to landfill but it could be separated for composting and sold to local gardeners or used in a community farming project.

Objectives

To further reduce waste going to landfill to 50%. This is best achieved by recycling paper/cardboard and introducing recycling of organic waste.

Food Packaging and Plastic Bags

Food packaging is the predominant source of domestic waste.
It can be reduced by:

- Buying local, buying fresh – fresh food doesn't have as much packaging as mass produced products. There's also less transportation with locally produced goods.
- Refuse plastic bags – using reusable cotton bags limits plastic bag waste. 6 Billion plastic bags are used in Australia every year (about 1 bag per person per day), tied end to end they would wrap around the Earth 37 times! Huskisson recently became the first NSW town to become a plastic bag free zone.

Vs.

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Performance

Results are difficult to quantify. If retailers are forced to charge 4c per plastic bag (Ikea and Bunnings already do this) and a cotton bag costs $2 then it would take around 50 trips to payback. The average family uses around 1200 bags per year.

Total Retail/Commercial Saving	1%
Payback Period	Instant
Total Waste saved over whole Commercial/Retail development (no of 3.5 Tonne skips filled)	4

Reducing and Reusing Office Waste

Commercial Offices

Using porcelain, re-usable mugs reduces polystyrene-foam cup waste.

Printing paper on both sides, using refillable pens and pencils and reusing envelopes and folders are all ways to reduce resource use in the office.

Old computer equipment and used printer inkjet and toner cartridges should be recycled rather than going to landfill.

Periodically, companies should be encouraged to recycle old computers and printers through special collection services. The printers can either be donated to charitable services or, if sufficiently old, broken down into correct waste streams

As little as 15% of waste is recycled in an office even though up to 60% of waste could be recycled/re-used.

Paper and Cardboard waste should be recycled using blue wheelie bins. This is particularly crucial in small office/retail units where bins are not often provided, even one central bin shared amongst 3 or 4 units would improve recycling. However, ownership/emptying issues are more complicated than providing one bin each.

Performance

It is very difficult to quantify the savings available, people can only be encouraged to reuse/recycle items. However, there is little capital cost in providing wheelie bins and areas for old computers to be left prior to collection.

Total Retail/Commercial Saving	46%
Payback Period	instant
Total Waste saved over whole Commercial/Retail development (no of 3.5 Tonne skips filled)	196

Vermiculture and Composting

Vermiculture (worm-farming) and composting are excellent ways of reducing food and green waste

- Composting can break down grass cutting, plant pruning and pre-plate food (vegetable peels) into valuable compost. Compost can give extra nutrients to vegetables and plants and act as a mulch to reduce water loss from the soil. It can be used on lawns but it must be spread very finely.
- Worm farms break down post-plate food waste into a valuable fertilizer and compost-type product. Worms eat their way up through the food waste leaving behind castings (excrement) that makes good compost. Urine seeps to the bottom and can be tapped off to use as liquid fertilizer. Also, worms can be removed from the farm and used as bait for fishing.

Neither of these processes produce any nasty smells or waste. During composting heat is produced that kills harmful bacteria, but it requires plenty of air so the bin needs to be purpose made and well ventilated. Worm farms are more self- contained and require little or no human intervention, the worms will eat anything organic apart from meat, onions and pet excrement.

Performance

Composting and Vermiculture can reduce organic and food waste to zero, so long as the compost can be used within landscaping or community farming. A commercial worm-farm and compost bin setup could cost less than $5000 and provide over 70 tons of compost to sell or use in a community farm.

Total Commercial/Retail Waste Saving	15%
Payback Period	< 2 years
Total Waste saved over whole Commercial/Retail development (no of 3.5 Tonne skips filled)	64

Waste Sorting

65% of waste in the commercial kitchen can be easily sorted, the biggest problem is that when preparing food most of us don't have the time to go out to of the kitchen to the central storage area to divide the rubbish into the relevant bins so instead all rubbish just goes into the one kitchen bin. Providing waste sorting bins within the kitchen encourages recycling by making it easy to sort at source.

There needs to be at least two bins, one for waste and one for recyclables, although ideally there needs to be one bin for each waste stream; one for food waste (vermiculture/composting), one for paper, one for recyclables and one for waste.

Performance

Up to 65% of commercial kitchen waste can be recycled, reducing landfill. The provision for kitchen sorting bins could be tied into tenancy agreements.

Total Commercial/Retail Waste Saving	Unknown
Payback Period	N/A
Total Waste saved over whole Commercial/Retail development (no of 3.5 Tonne skips filled)	Unknown

Waste Reduction - Recommendations

Mandatory

A full Waste Management Plan should be drawn up for the project. This would allow the commercial development to achieve a 50% reduction in waste going to landfill. This targets could be achieved with;

- Sorting of all paper and cardboard waste by providing sorting bins to every office/retail unit. This would prevent 46% of waste to landfill.
- Elimination of plastic bags or utilising bio-degradable product – reduces landfill by 1% but bags can pollute waterways and do not breakdown over time.
- 80% recycling rate of waste during construction (see materials)

Encouraged

- Composting of organic waste from the retail development – diverts 14% of landfill waste to create a rich product valuable to local farmers/gardeners.
- Plastic bag free zone: Elimination of plastic bags or utilising bio-degradable product – reduces landfill by 1% but bags can pollute waterways and do not breakdown over time.
- Organic waste separation will be encouraged particularly from the retail food outlets

Emerging technologies

- The use of organic waste for biomass energy generation was considered on a micro and macro level

Performance

Providing the definite features will save up to 60% of commercial waste with the veggie patch/composting providing nearly a quarter of that (which is not done presently)

Total Commercial/Retail Waste Saving	62%
Payback Period	< 2 years
Total Waste saved over whole Commercial/Retail development (no of 3.5 Tonne skips filled)	265 skips

Materials Use

Background

A typical building might have embodied energy in its construction which could be equivalent to up to 20 years of operational energy.
The materials considered should be assessed in accordance with ISO 14040 with respect to their:

- Impact on indoor air quality through volatile organic compound (VOC) emissions and toxic pollution from disposal
- Resource efficiency due to depletion of natural resources, recyclable content and end-of-life reusability and recyclability
- Environmental consequences from the impact on the ecosystem where the raw material is extracted or grown
- Embodied energy used to mine or grow, transport, process, and manufacture including distribution and transport to site
- Maintenance requirements and durability
- Packaging and waste

Objectives

Recycle 80% of waste during construction by ensuring that multiple sorting bins are provided
Achieve a high level of indoor air quality by selecting materials with low volatile organic compound (VOC) emissions
Reduce PVC use by 50%

Materials

Material	Considerations	VOC Emissions	Resource Efficiency	Environment Impact	Embodied Energy
Timber	Natural, renewable, readily available and easy to work	None	Renewable	Low	Low
Aluminium	High strength to weight, natural corrosion resistance, shaping ease	Process	Recyclable	High	High Low for recycled
Steel	Flexible, readily available	Process	Recyclable	High	High
Copper	Corrosion resistant, expensive	Process	Limited	High	Medium
Concrete	Flexible, high thermal mass, readily available	None	Limited	Medium	Low
Glass	Transparent	None	Recyclable	Medium	Medium
Wool	Natural, renewable, fire resistant	None	Renewable	Medium	Low
PVC	Flexible, high strength to weight	Disposal	Not Recyclable	High	Medium

Options	Considerations	Performance	Cost
Zero VOC emission paints	Limited colour range available	Improvement of indoor air quality	
Natural carpet materials	Wool considered best carpet material	Improvement of indoor air quality	
Provision of EcoPackage	Advice on finishes and furnishings	Improvement of indoor air quality	
HDPE pipework rather than PVC	Non chlorine plastics are easier to dispose of at end-of life and have less toxic by-products during manufacture	Reduction of PVC by 50%	

Reducing PVC Use

PVC

Polyvinylchloride is versatile building product that is cheap to produce. It can be formed into a wide variety of shapes and sizes for a huge range of uses from guttering, to window frames to floor coverings.

Unfortunately, research is showing increased environmental penalties for using PVC. Greenpeace are calling for a worldwide ban on PVC production and even other organisations are requesting a reduction in its use. Environmental issues include:

- Mercury pollution – process water has trace mercury content but is often dumped into rivers and oceans. While admittedly recent guidelines are reducing mercury pollution, in previous times PVC producers have been terrible polluters.
- Vinyl Chloride – has been linked to cancer and birth defects. Normal emissions are controlled but it is known that when cooling systems go down, emergency shutdown procedures dump the vinyl chloride prevent the plant blowing up.
- Persistent organo-chlorines – Dioxins, Furans and PCBs that are created during manufacture are released into the atmosphere and have been known to lead to breast cancer, lower sperm counts and reproduction related birth defects in men. In fact, the increasing proportion of women to men across the globe could be due, in part, to PVC.
- Danger from Fires – when PVC is burnt at low temperatures it produces hydrochloric acid and a range of other toxins. Also, over time electrical cabling and hot water pipework will gently decompose emitting dioxins that can affect the heart.
- Recycling – PVC is very difficult to recycle because of the additives. Industrial waste from a single source can be recycled but post-consumer waste is nearly impossible to sort. PVC can be incinerated to provide heat but it is not very efficient. PVC that is accidentally mixed in with recyclable plastics will ruin the batch. PVC does not degrade (attested to by the PVC liners used for landfill sites)

From a report at www.buildinggreen.com/features/pvc/pvc.cfm

Performance

- PVC use should be reduced by at least 50%
- Alternative materials are available for all of current PVC uses. Though this may incorporate additional cost, it would have considerable environmental benefit.

Materials - Recommendations

Mandatory

- A materials matrix will be developed during the design development stage of the project. The matrix will consider environmentally friendly alternatives to building materials and finishes. The materials will be assessed in terms of embodied energy, recycled materials content, ease of recycling of the material, durability and the effect the material has on the indoor air quality.
- A target of achieving a 50% reduction in PVC has been established for the project. This will be achieved by the use of HDPE pipework instead of PVC, the use of steel rainwater gutters, the use of composite material alternative to PVC cables.

Encouraged

- The benefits of selecting materials that have a positive effect on the indoor air quality will be described to potential tenants. Such materials such as natural wool carpets, sustainable timber floors and natural based paints will be encouraged.
- 80% recycling rate of waste during construction

Emerging technologies

- The use of new environmentally friendly materials such as *Easy Board* for internal walls and alternative roofing materials will be considered.

Performance

Providing the encouraged features will save up to 80% of construction waste

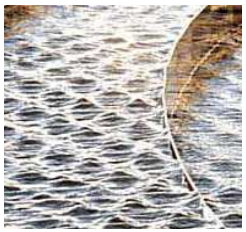
Total Commercial/Retail Construction Waste Saving	80%
Payback Period	
Total Waste saved over whole Commercial/Retail development (no of 3.5 Tonne skips filled)	Unknown

Overall Recommendations

Options for reducing energy and water use and waste generation have been presented, if these are integrated into the design then Vincentia will be a significantly ecologically sustainable development, far surpassing current best practice design.

Some options are extremely cost effective and should be included as a matter of course. Other options have slightly longer payback periods that require more environmentally based investment than simple monetary return, these should be further investigated in subsequent design stages to ensure the non-monetary benefits make them worthwhile.

Total Commercial/Retail Energy Saving	35%
Payback Period	< 5 years
Total Greenhouse Gas Avoided over commercial/retail development (No of cars taken off the road)	150 Cars



Total Commercial/Retail Water Saving	53%
Payback Period	10 years
Total Water saved over whole commercial/retail development (no of Olympic-sized pools filled per year)	19 Pools

Total Commercial/Retail Waste Saving	62%
Payback Period	2 years
Total Waste saved over whole Commercial/Retail development (no of 3.5 Tonne skips filled)	265 Skips

Initiatives have been recommended for material selection and transport provisions that will significantly improve indoor air quality, amenity of buildings and surroundings and reduce material use and vehicle emissions.