SYDNEY UNIVERSITY

The University of Sydney

SUSTAINABLE DESIGN
PROJECT APPLICATION REPORT

CENTRE FOR OBESITY, DIABETES AND CARDIOVASCULAR DISEASE

STEENSEN VARMING

BRISBANE CANBERRA MELBOURNE SYDNEY

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1 INTRODUCTION

The following report has been prepared as part of the Sydney Universities, Centre for Obesity, Diabetes and Cardiovascular Disease (CODCD) Project Application to summarise the specific sustainability initiatives targeted on the project.

The CODCD facility will be an eight storey building over two basements and will incorporate car parking, education/ teaching space, specialist research facilities such as general laboratories, and PC2 and PC3 containment areas, support spaces, offices and meeting rooms.

The report shall be read in conjunction with associated documentation produced by the Architect, BCA Consultant etc.

The report reflects the relevant stage of design and should not be seen as a Scheme Design Report that discusses system options and design approach. Due to the early stage of the design development a number of issues will need to be addressed in more detail as progress takes place in order to address appropriate and responsible implementation of solutions to meet the financial, functional and environmental expectations of the project.

It is not intended that the general schematic design detailed in this report will be viewed as finalised or fixed; the design will continue to be developed and refined as the project progresses into the next and more detailed phase of the project.

2 OVERVIEW

The University is committed to reduce net energy use through efficient design; promote water efficiency; reduce green waste through on-site recycling; use intelligent building management systems; use recyclable construction.

In accordance with good practice it is intended that sensible and appropriate levels of technology and design be applied to reduce energy wastage and carbon dioxide emissions arising from the operation of the facility both for financial and environmental reasons without reducing the functional standards necessary. It is also intended to select materials and equipment, which have low toxicity levels and sustainable production techniques where appropriate.

Being a laboratory building, it is anticipated that the CODCD will have energy demand and water consumption. In order to reduce the load, the Architectural design has incorporated passive design measures to minimise energy consumption associated with air conditioning, lighting etc. Due to the specialised nature and core function requirements of the CODCD building some passive design opportunities relating primarily to physiological issues and reducing energy consumption are considered as not appropriate.

Our design philosophy is to provide both appropriate and sensible initiatives for the project that align with and support the functional and operational requirements for a highly serviced laboratory building of this nature.

The ESD initiatives that have been considered appropriate for the CODCD project go beyond current regulatory requirements and standard practices and are based on international best practice benchmarks and guidelines. A key priority for the building is to implement sound energy saving initiatives. With respect to the energy component, our design intent has been to:

1. Minimise energy consumption – through high efficiency building envelope

   Building envelope is designed to maximise daylight access to areas where it is desired, but controls glare and solar heat gain via appropriate shading devices. (This reduces energy associated with lighting as well as air- conditioning)

2. Energy-efficient energy production – through energy efficient systems like cogeneration
3. Maximise on site renewable energy production – solar, geothermal, photovoltaics
4. Encourage operational training and education
5. Suggest ongoing testing, commissioning and calibration of systems.

In accordance with the above initiatives, energy efficiency and use of renewable energy sources have been established as fundamental project goals. Sensible and appropriate design measures have been considered to reduce energy wastage and carbon dioxide emissions arising from the operation of the facility without reducing the functional standards necessary for a highly serviced building of this nature.

With the application of the proposed ESD strategies, a target reduction in energy consumption in the order of 30-40% is expected. This will establish the facility as a world leader in sustainability and energy efficiency when compared with other similar facilities. Preliminary analysis indicates that the two key ESD initiatives being proposed, namely trigeneration and the geothermal heat exchanger has the capacity to reduce carbon emissions by 5,400 tonnes per year which is equivalent to taking 1,300 cars off the road.

3 OVERALL VISION/TARGET / BENCHMARK

As part of the CODCD development, the University of Sydney is committed to reducing its carbon footprint and to demonstrating its environmental leadership among Australian and international peer research universities.

The University values the ability to position the CODCD design and performance within the context of similar laboratory projects, both in Australia and abroad, to the extent that the project will seek to exceed best practice for its building typology. The University recognises the need to address the requirements of a formal green building rating certification, as well as best practice benchmarks for other performance indicators.

In accordance with good practice it is intended that sensible and appropriate levels of technology and design are applied to reduce energy wastage and carbon dioxide emissions arising from the operation of the facility both for financial and environmental reasons without reducing the functional standards necessary. It is also intended to select materials and equipment that has low toxicity levels and sustainable production techniques where appropriate.

The University is committed to developing the CODCD project as a benchmark academic laboratory precinct in a dense urban context, with best practice design approaches and appropriate technology that would establish the project as a benchmark for excellence in Australian design.

The sustainable design targets for the project are based on University of Sydney's Design brief for CODCD, which clearly establishes that the University's design philosophy primarily focuses on environmental sustainability and energy efficiency.

The University intends to attain a formal certified Green Star rating to establish the University as an environmental leader.

In addition to the Green Star environmental initiatives, additional international environmental rating systems, namely, BREEAM, Green Guide for Healthcare (GGHC) and Laboratories for the 21st century (Labs21) have been taken as guidance to set relevant ESD benchmarks.

Green Star is an Australian voluntary national environmental rating system. BREEAM is a voluntary rating system in the UK and Labs 21 approach seeks to create laboratories with reduced emissions and low energy and water usage. Additionally GGHC has also been referred, since it is a best practices guide for healthy and sustainable building design, construction, and operations for the healthcare industry. GGHC has been considered as relevant guidance tool because the function of the CODCD building primarily relates to human health.

4 KEY ESD INITIATIVES

4.1 OVERVIEW

The sustainability aspects of the building have been fully integrated and articulated within the built form and are based on proven systems and detailed studies carried out during the concept design stage.

Key operating priorities of the building that include high outside demand, energy intensive functions and operational 24 hour based loads have been targeted to achieve design outcomes that deliver in a multifunctional sense significant reductions in energy and water demand when compared to traditional approaches.

The result is an elegant sustainable outcome for the University, the building and the building users and the local community and sets a new benchmark for research facilities of this nature.

Secondary to these key achievements is a suite of initiatives captured by the project specific rating tool that has been developed to ensure all relevant environmental credit indices from both local and international rating tools are captured.

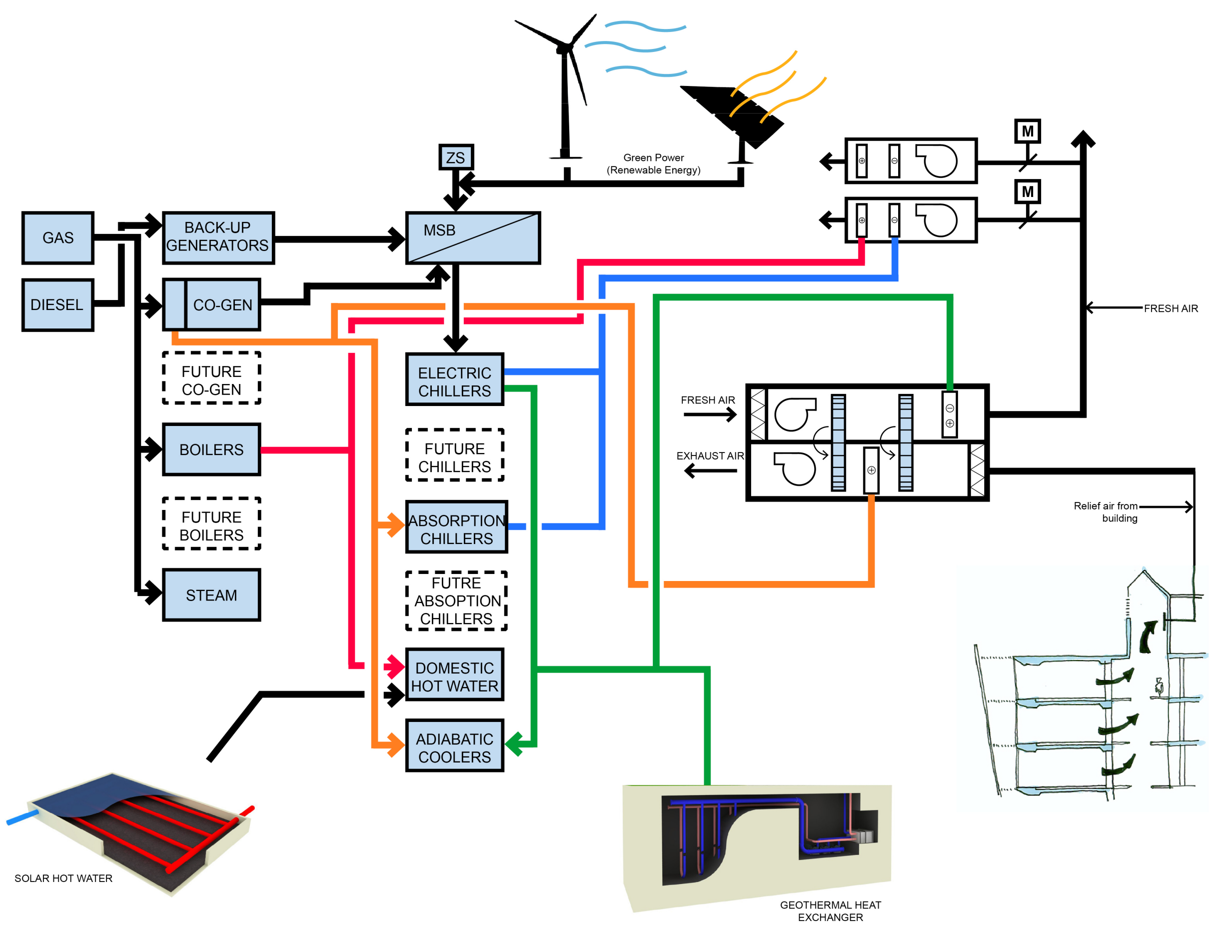

Figure 1 – Optimum System Arrangement

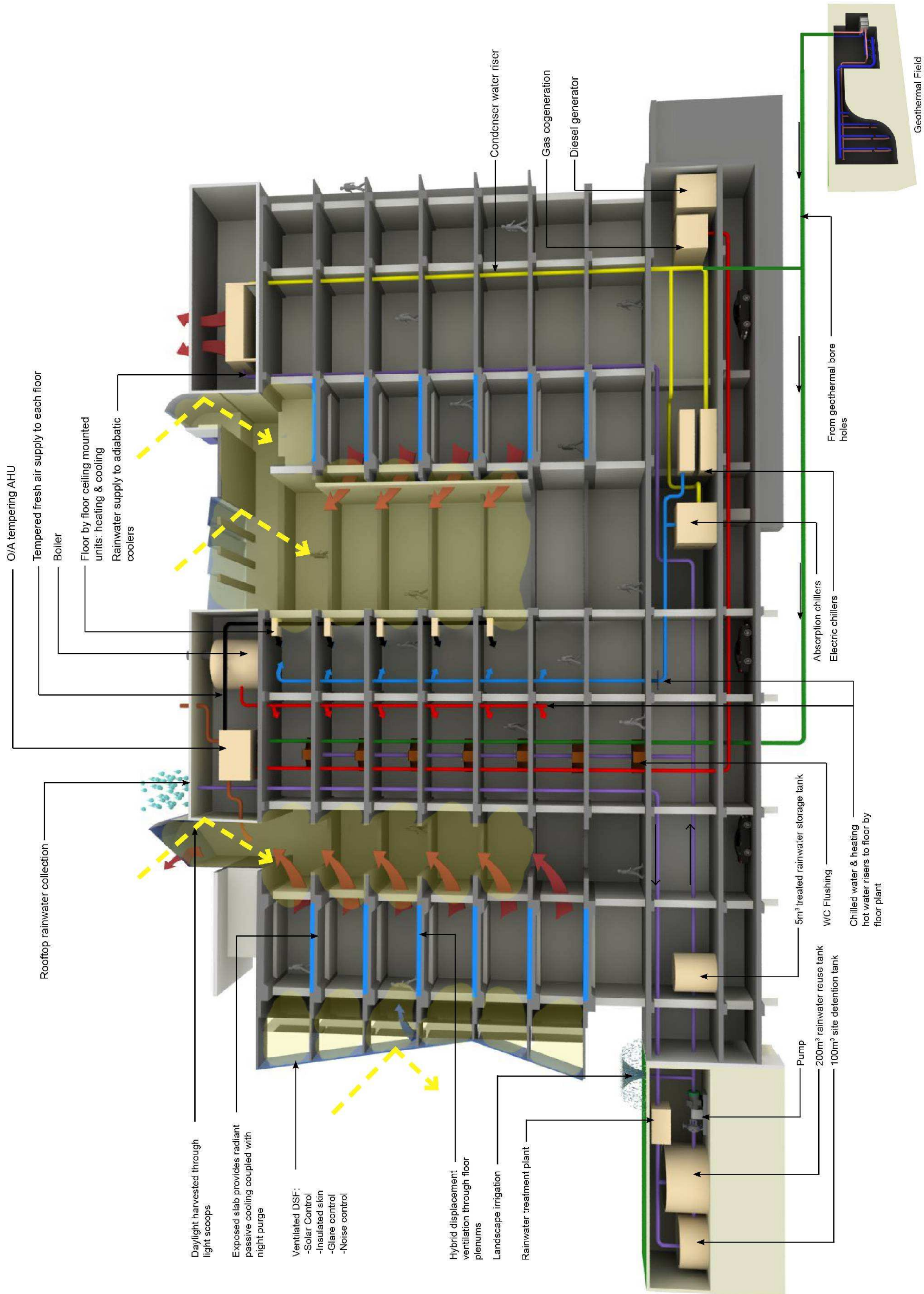

Figure 2 – Sustainable Initiatives Schematic Diagram

4.2 GEOTHERMAL HEAT EXCHANGER

A large geothermal heat exchanger with a capacity in the order of 3MW is proposed to provide a renewable means to offset the heating and cooling loads of the building. As ground temperatures remain relatively stable throughout the year the system has been arranged to target a net energy balance throughout the year whereby heat rejected to the earth during summer periods is used during winter to offset heating loads. Preliminary analysis indicates that the system has the capacity to reduce carbon emissions by 1900 tonnes per year or take 500 cars off the road.

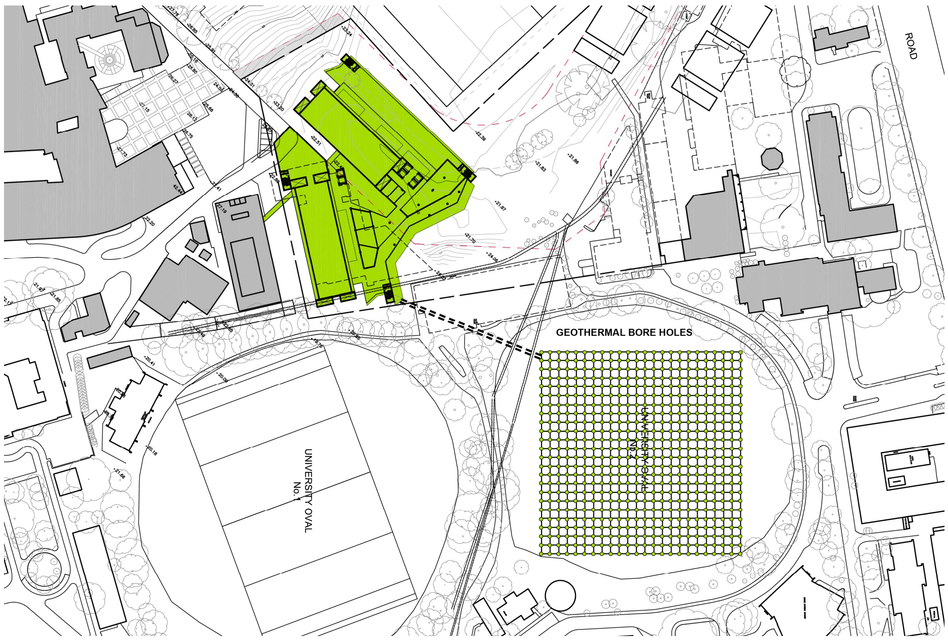

Figure 3 – Proposed geothermal field location

4.3 TEMPERED MAKE-UP AIR (FULL FRESH AIR SYSTEMS)

Due to the high fresh air demands of the building large air handling units will temper incoming outside air before it is delivered to the various air conditioning systems throughout the building. The units will utilise thermal wheels to recover energy from relief air, use desiccant wheels to remove humidity from incoming fresh air using waste heat from the cogeneration units to reactivate the desiccant and release moisture to the exhaust air stream. Water from the geothermal field will also be used to temper the incoming fresh air by cooling in summer and heating in winter.

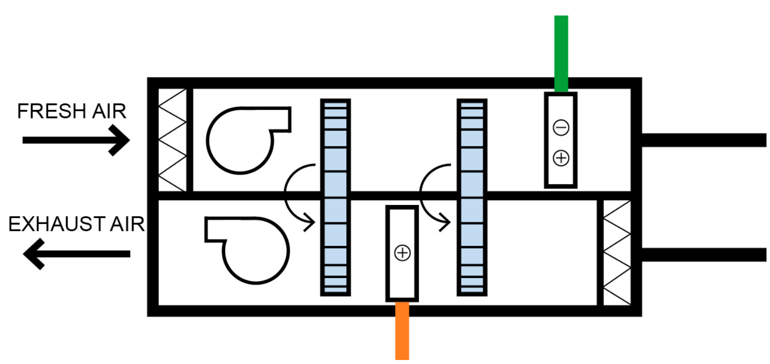

Figure 4 – Fresh air tempering unit schematic

4.4 TRIGENERATION

Trigeneration has been assessed in detail and will comprise gas driven engines coupled with absorption chillers. Electricity produced by the generators will offset base load power demands with the high grade waste heat from the generators used to produce chilled water via absorption chillers with the low grade waste heat used as the heating medium for the desiccant wheels using the outside air tempering units. Preliminary analysis indicates that the system has the capacity to reduce carbon emissions by 16% over conventional systems.

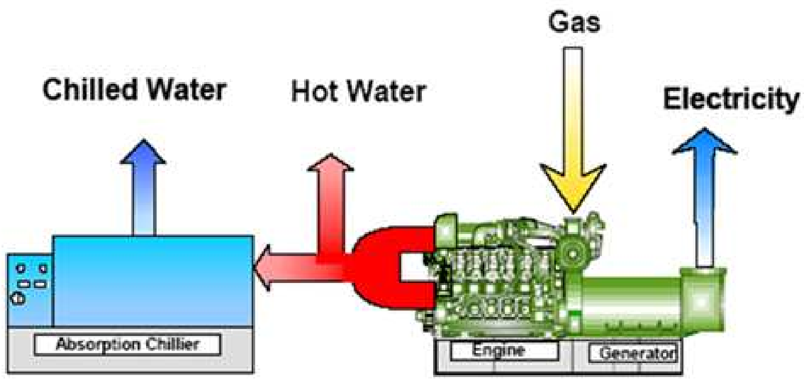

Figure 5 – Typical Trigeneration Schematic

4.5 DAYLIGHT ACCESS

Access to views and daylight for staff and students is a key attribute in achieving a good outcome in terms of human environment and creating a light and airy space. Three large voids / atria have been incorporated into the building to harvest daylight from the roof into the core of the building. The skylights are arranged with northerly orientations to capture a high abundance of daylight. Overhangs shade high level summer sun whilst curved profiles in the throat reflect light down each void. At higher levels modelling has demonstrated that illumination from daylight is sufficient to offset electric lighting and hence reduce energy consumption.

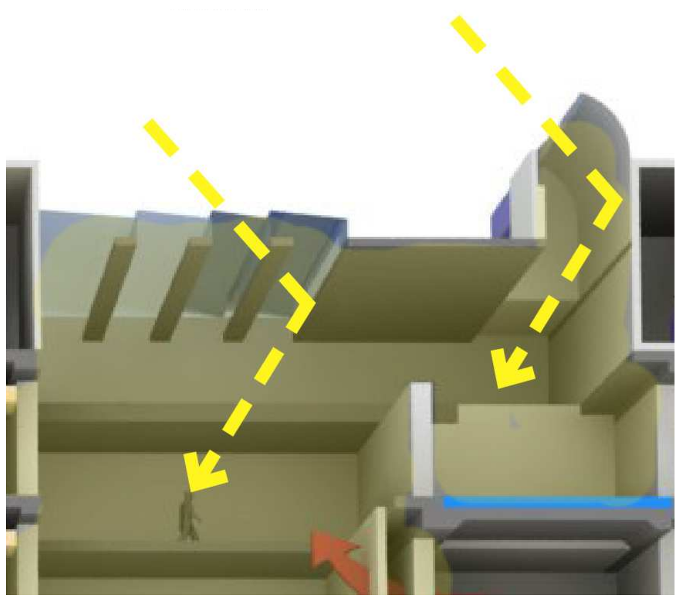

Figure 6 – Skylight Arrangement

4.6 HYBRID DISPLACEMENT VENTILATION TO OFFICE AREAS

Another important factor in providing a good human environment is indoor air quality. Displacement ventilation system comprising low level supply air to office areas coupled with in floor fan coil units to manage perimeter loads or internal meeting rooms is proposed. The system utilises raised floor plenums to distribute conditioned air which enters the space via floor grilles. The high floor to floor ratios and exposed mass ceilings blend well to support this approach. Relief air enters the central voids where it is collected at high level and heat is recovered via the tempered air handling units located on the roof top plantrooms before being discharged to outside. The raised floor plenums also provide a path for the reticulation of power and data cabling offering unlimited flexibility in space planning arrangements during the life of the building which is particularly important for any research orientated buildings.

4.7 DOUBLE SKIN FACADE

The northern and north westerly facades are veiled in a fritted glazed facade that from an architectural perspective strengthens the light and airiness of the building. The facade is multifunctional in achieving a system that provides a mechanism that filters light, view, climate, solar loads, glare, noise, maintenance, thermal comfort, weather protection and aesthetics. There are also opportunities to incorporate PV's in areas for shading and renewable power generation.

4.8 NIGHT PURGE

Openings are provided in the facade that allows cool night air to enter the building to purge residual heat gains accumulated during the day and recharge the exposed mass. Night purge is proposed for the office areas only and during fire mode provide make-up air to the smoke exhaust system.

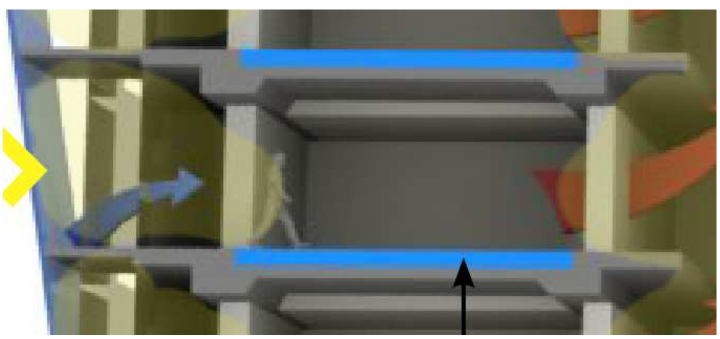

Figure 7 – Night Purge through office areas

4.9 BUILDING SPECIFIC RATING TOOL

The proposed CODCD facility contains education and health related research / laboratory areas. There is no environmental performance rating tool that can be effectively applied to the CODCD development that captures the unique principles relevant to the function and use of this facility.

The following local and international environmental assessment tools have been analysed to identify the most appropriate ESD initiatives that could be adopted for the proposed CODCD development. Based on these rating tools, a project specific “Environmental Assessment Matrix” has been developed in order to guide the design process and help achieve a low energy and sustainable building against local and internationally acknowledged rating tool indices.

	Rating Tool	Country of Origin
1	Green Star Education	Australia
2	Green Star Healthcare	"
3	BREEAM Education	UK
4	BREEAM Healthcare	"
5	LEED New Construction	USA
6	Labs 21	"
7	Green Guide for Healthcare	"

In addition to Labs21, the design of the mechanical installations shall also be based on a modified Green Star rating scheme with targeted environmental initiatives appropriate to Laboratory design.

The Appendix includes the ESD performance initiatives targeted for the design and construction of the proposed new facility.

4.10 WATER EFFICIENCY MEASURES

The following initiatives are currently proposed by Warren Smith and Partners for Hydraulic services.

4.10.1 Roof Rainwater Collection including Façade Rainwater Capture

Given the roof area, we calculate the optimum rainwater reuse tank size to be 200m3 capacity. Rain water will be used for WC flushing and make-up water supply to the adiabatic coolers.

4.10.2 HDPE Pipework

HDPE Pipework can be installed in lieu of UPVC pipework.

4.10.3 Efficient Fixtures and Fittings

The following can be installed:-

Water Efficient Fixtures

Four (4) star rated WC 3/4.5 litre flush

Five (5) star cube wall hung urinals with sensor 0.8 litre flush

Water Efficient Tapware

Five (5) star rated mixer taps

Five (5) star rated shower heads and tapware water outlets will be provided

4.10.4 Landscape Irrigation

The irrigation water to be supplied from the rainwater reuse tank and drip irrigation to be installed rather than spray irrigation to conserve water.

4.10.5 Water Efficient Urinals

0.8 Litre sensor flush water efficient urinals with flushing water supplied from the rainwater reuse tank.

4.10.6 Solar Hot Water

Solar Hot Water with natural gas boosting for both potable and non potable hot water systems can be provided.

4.10.7 Fire Services Test Water

Fire Services Test Water from Fire Systems and fire pumps to be discharged for reuse into the rainwater reuse tank.

4.10.8 Stormwater Pollution Control Devices

Suitable Gross Pollutant Traps (GPT's) will be provided to the stormwater drainage system exiting the site.

4.10.9 Water & Energy Metering

Water meters will be provided to record and monitor water consumption to each floor on the building and to hot water heaters and tanks.

Natural gas meters will be provided to record and monitor natural gas consumption to hot water heaters and the Café Commercial Kitchen.

4.10.10 Adiabatic Coolers

Adiabatic coolers are proposed in lieu of traditional cooling towers to further reduce potable water consumption.

4.11 PASSIVE ENERGY EFFICIENT MEASURES

In addition to the key measures described previously the following standard passive measures are able to reduce energy wastage:

- A well insulated and sealed external building envelope with thermal mass to dampen the effect of external environmental conditions.
- Fenestration ratios to achieve good views and daylight factors for natural light penetration whilst addressing the effects of solar gain/glare to perimeter spaces. High efficiency glazing is recommended to reduce direct solar/ thermal gains whilst having minimal impact on total daylight transmission, with internal blinds for glare control.
- Room heights designed to achieve a sensible balance between functional need and economy.
- Maximisation of natural ventilation where appropriate for both ventilation and cooling purposes.
- Maximisation of natural daylighting where appropriate linked to the artificial lighting system to reduce energy wastage.

4.12 OTHER ACTIVE ENERGY EFFICIENT MEASURES

In addition to the key measures described previously the following active measures will be incorporated into the design in order to reduce energy wastage: -

- Heat recovery in the form of run around coils or cross flow heat exchangers from extract ventilation systems will be incorporated into the system design where appropriate potential sources of heat recovery exist.
- Excess relief air from the building office spaces is naturally released through the three main void spaces reducing need to provide dedicated air conditioning to these areas whilst maintaining a good buffer zone between the offices, laboratories and outside.
- Hot water boiler plant to handle local zone heating in lieu of energy inefficient electric heating.
- The use of energy efficient motors, with variable speed drives where appropriate, for pumps and fans.
- Control facilities via local and remote stations enabling plant usage to match occupancy patterns etc.
- Separation of engineering systems to serve building zones with similar environmental and occupancy characteristics to allow differing requirements to be controlled separately and to achieve maximum turn down.
- Efficient pipe runs and insulation of distribution pipework and ductwork to minimise unwanted heat gains/losses.
- Possible inclusion of thermal storage devices to address peak loads and maximise plant efficiencies.
- Energy efficiency is an important factor in lighting design. Therefore, it is proposed to use luminaries incorporating efficient fluorescent and high intensity discharge lamps wherever possible. (Note that this shall not be proposed where it conflicts with the functional, conservation and display requirements of spaces).
- Combined with using energy efficient lamps, lighting control systems shall also be incorporated to reduce energy usage via photo-electric cell and time clock control, to switch lamps off when sufficient daylight is provided. (Note that this shall not be proposed where it conflicts with the functional, conservation and display requirements of spaces).

4.13 SUSTAINABLE MATERIALS

Consideration will be given to materials of low embodied energy content, high recycled content and/or highly recyclable. In addition to impact of the material, the construction technique for systems is being assessed to favour those systems that reduce requirements.

Material selection is an important aspect of environmental design because building materials consume energy and natural resources during its manufacture and for their transportation to the construction site.

All materials have an associated embodied energy. Embodied energy is the energy consumed by all the processes associated with the making of a product, from the mining and processing of natural resources to manufacturing, transport and product delivery.

Materials with the low embodied energy intensities, such as concrete, bricks and timber, are usually consumed in large quantities. Materials with high energy content such as stainless steel are often used in much smaller amounts. As a result, the greatest amount of embodied energy in a building can be either from low embodied energy materials such as concrete, or high embodied energy materials such as steel.

For the proposed CODCD development, we intend to select the best combination of materials based on transportation distances, availability of materials and budget, balanced against known embodied energy content.

To minimise embodied energy the design should, wherever possible:

- Use locally sourced materials in order to reduce transportation
- Select low embodied energy materials (which may include materials with a high recycled content)
- Select materials that can be re-used or recycled easily at the end of their lives using existing recycling systems
- Give preference to materials manufactured using renewable energy sources
- Use building envelope design to minimise materials e.g. minimise ductwork reticulation

At the minimum, the following items would be included in the material selection:

- Recycled content of concrete
- The amount of Portland cement would be reduced by replacing it with recycled concrete.
- Recycled content of steel
- Recycled steel products would be used for a part of the structural steel members.
- PVC minimisation
- Traditionally fume cupboards are made of PVC. In order to minimise the usage of PVC, we have identified alternative materials that are available for fume cupboard ducting.
- All the services infrastructure would consider alternative materials to PVC. This includes (hydraulic, mechanical and electrical cabling, conduits etc.)
- Sustainable timber
- Timber sourced from sustainable resources or Forest stewardship Council certified (FSC)
- Recycled content & reused products and materials
- Rapidly renewable materials

- Recycling waste storage
- Floor slabs, where practical, will be built using a system that dramatically reduces the use of timber formwork.
- Timber from sustainably managed resources will be sourced in preference for the development.
- Evaluation of environmental impact of materials will form part of the final selection criteria as will life cycle costing.
- Finishes will be selected that reduce potentially harmful off-gassing.

4.14 LABS 21 NETWORK

Steensen Varming is a member of the Labs21 Network. Labs21 is dedicated to the pursuit of sustainable, high performance, and low-energy laboratories that will:

- Minimize overall environmental impacts.
- Protect occupant safety.
- Optimize whole building efficiency on a life-cycle basis.
- Establish goals, track performance, and share results for continuous improvement.

To demonstrate their commitment to this philosophy, Labs21 Partners commit to the following:

- Adopt voluntary goals.
- Assess opportunities from a "whole buildings" approach.
- Use life-cycle cost analysis as an important decision-making tool.
- Incorporate a comprehensive, whole building commissioning process into new construction and retrofit projects.
- Employ a range of energy and water efficiency strategies.
- Measure energy and water consumption and track emission reductions.
- Evaluate on-site power generation, combined heat and power technologies, and renewable power purchases.
- Build with "green" construction materials.
- Promote energy and water efficiency efforts.
- Expand beyond the laboratory building.

Labs21 seeks to create environmental showcase laboratories by encouraging laboratory owners, operators, and designers to adopt the "Labs21 Approach." This strategy involves taking an initial evaluation of a laboratory's energy use from a comprehensive perspective when considering efficiency improvements. This requires focusing on all of a laboratory's energy systems and wastes, including its HVAC and electrical power supply, rather than focusing on specific energy-using components.

Such an approach allows laboratory owners and operators to pursue integrated energy and water conservation measures with significantly higher efficiencies and cost savings than the traditional approach of addressing components sequentially or individually. Adopting the Labs21 Approach will encourage laboratories to: 1) make capital investment decisions based on life cycle cost savings; 2) pursue advanced, energy-efficient HVAC technologies; 3) design systems that recover and exchange waste heat and other forms of free energy; 4) incorporate renewable energy systems.

The resulting showcase facilities will reduce emissions, streamline energy and water usage, and decrease overall costs—all while preserving the integrity of the laboratory's mission.