ESD and Energy Efficiency Report
UTS Broadway Building
University of Technology Building

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Contents

1. Executive Summary

This report demonstrates the commitment to sustainability in terms of energy efficiency and resource efficiency for the UTS Broadway Building project. This document has been prepared on behalf of the University of Technology Sydney for submission with Part 3A application. The report is in reference to item 5 of the Key Assessment Requirements of the Director-General Requirements.

Sustainability Commitment

The project is committed to the following Sustainable Design objectives:

- Achievement of 5 star Green Star Education v1 design rating certified with Green Building Council of Australia
- Energy efficiency through implementation of appropriate technologies and passive design measures against relevant industry benchmarks
- Water efficiency through the use of rain water capture and building reuse
- Improvement of indoor environment through the integration of external environment through atrium
- Minimisation of operational emissions
- Transportation alternatives for students and staff
- Minimisation of waste production in construction and operation

Sustainability Initiatives

The project is to implement a number of design initiatives that promote:

- Energy conservation
- Reduced greenhouse gas emissions through design and building management
- Water conservation measures
- Reduced stormwater runoff / output from the site
- Alternative modes of transport
- Integrate future occupant requirements
- Comfortable and happy indoor environments
- Connection with exterior environments

Sustainability Measures & Performance

The project is to measure the sustainability performance of the development through the following measures and environmental savings compared to relative industry benchmarks:

Resource	Measure	Method for Tracking Usage	Measures to Minimise / Mitigate
Energy	$kgCO_2$-e per annum (GHG) kWh per annum	Electrical meters & sub-meters for different plant, equipment & spaces	Natural ventilated spaces High performance façade systems Efficient plant & equipment Efficient fixtures
Water	ML per annum L per person per day	Water meters for all major water uses	Rainwater harvesting & reuse Stormwater management on site Reduced flow ratings on fittings

Resource	Measure	Method for Tracking Usage	Measures to Minimise / Mitigate
Materials	Embodied energy Embodied water	Lifecycle assessments on material quantities consumed in construction	Materials supplements with waste materials Recycling and reuse of materials
Building / Site Wastes	T Wastes per week ML per annum	Waste receipts Stormwater capture	Recycling facilities on site Stormwater reuse within the building
People Movements	$kgCO_2$-e per annum (GHG)	Surveys of staff and usage rates of alternative modes of transport	Cyclist facilities Public transport access

2. Sustainable Design

2.1 Purpose of Report

This report has been prepared to demonstrate a commitment to sustainability for the proposed UTS Broadway Building at The University of Technology, City Campus, in accordance with relevant planning standards and policies. The proposed development has considered the elements of energy and water efficiency, transportation, waste & building management. The project will convert an existing site into an effective teaching building that is able to cater for additional activities of the University staff and students.

The sustainability objectives to be met for the project have considered the limitations and opportunities of the existing site, environmental amenity of the surroundings and relevant planning policies. This report has been prepared on behalf of University of Technology Sydney for submission with the Part 3A development application.

2.2 Sustainability Goals

The following sustainability goals have been set for the project on review of the UTS Sustainability Policy, precedent projects and industry recognised green building standards:

1. 5 star Green Star Education v1 rating
2. Energy efficiency through implementation of appropriate technologies and passive design measures
3. Water efficiency through the use of rain water capture and building reuse
4. Improvement of indoor environment through the integration of external environment through atrium
5. Minimisation of operational emissions
6. Transportation alternatives for students and staff
7. Minimisation of waste production in construction and operation

This report has been prepared to demonstrate how the project will comply with the above goals.

2.3 Planning Provisions

The development is located within the local planning area of City of Sydney Council and is subject to Part 3A application. The development is subject to the following provisions and reference documents:

- Section 75F of Environmental Planning and Assessment Act 1979
- Waste Avoidance and Resource Recovery Strategy (Resource NSW)
- National Water Quality Management Strategy: Guidelines for Sewerage
- Systems - Use of Reclaimed Water (ARMCANZ/ANZECC)
- National Greenhouse Accounts (NGA) Factors (DCC)
- Guidelines for Energy Savings Action Plans (DEUS)
- Guidelines for Water Savings Action Plans (DEUS)
- Managing Urban Stormwater: Council Handbook. Draft (EPA)
- Managing Urban Stormwater: Treatment Techniques (EPA)

3. Sustainable Design

3.1 Sustainability Commitment

The project is committed to following Sustainable Design objectives:

- Achievement of 5 star Green Star Education v1 design rating certified with Green Building Council of Australia
- Energy efficiency in reference to industry benchmarks for educational facilities
- Appropriate management of wastes on site during operation and during demolition / construction phase of the development
- Water efficiency in reference to industry benchmarks for educational facilities

UTS' ESD Masterplan 2020

In order to ensure that the future development and design of the UTS City Campus has a defined direction in terms of sustainable design and performance a campus wide Masterplan was prepared. The aim of the Masterplan is to "offer clear recommendations for the strategies, performance targets and technologies that should be employed to meet the sustainable ambitions of UTS". Therefore the Masterplan has made a number of site wide recommendations in terms of energy and water consumption, ventilation strategies, lighting, material use in construction and operation and waste disposal and recycling.

The following section of this report describes the proposed initiatives that are to be incorporated into the development to achieve the above commitments.

3.2 Energy Efficiency

A number of energy efficiency initiatives are proposed for the project. The building is to be benchmarked against Green Star Energy assessment methodology for Education facilities recognised by the Green Building Council of Australia.

The following energy efficiency measures have been proposed for the project which satisfies the UTS key Sustainability Policy requirements and Director General Requirements for Energy efficiency:

- Implement energy conservation
- Reduce greenhouse gas emissions through design and management

UTS Design Guidelines

The UTS Design Guidelines have been prepared to aid in the design and documentation of UTS projects and "emphasise that UTS demonstrates and promotes the achievement of sustainable futures embracing ecological, economic and social aspects of human existence". These guidelines have been prepared to be used by professional consultants for guidance and direction with respect to the requirements of UTS.

In terms of energy efficiency the Design Guidelines outline a number of passive design initiatives to reduce energy consumption through utilising advantages of building design and site selection, minimising life cycle costs of design options and optimising the engineering services design. These Guidelines have been used in the design of the Broadway Building and its services and construction.

Trigeneration Plant

As part of UTS's commitment to reduce the environmental impact of its buildings and its emissions reduction targets a trigeneration system will be included in the design and construction of the

Broadway Building. This system will be gas fired and will provide electricity to the building and the waste heat used to provide heat and drive absorption chillers to provide cooling to the building. The inclusion of the trigeneration system will significantly reduce the energy consumption and carbon emissions of this building, it will also provide an excellent opportunity for education on this type of system for engineering students within the building.

Electrical Substation

This building will contain a new electrical substation, which will provide power to the building. The substation will provide the difference between the building's electrical load and the power supplied by the trigeneration system.

Outside Air Economy Cycles

The building mechanical services will incorporate outside air economy cycle to provide majority of building's cooling requirements over the year through the use of outside air when ambient conditions are mild. An outdoor air economy cycle can reduce cooling energy requirements by some 20% to 30% or around 5% of the air conditioning energy use when appropriate modifications are made to existing plant as required. It is expected that this initiative will provide good energy savings by reducing the cooling energy consumption of the building as outdoor air is utilised in lieu of return air during mild ambient conditions.

Services and Space Management

Mechanical services are to be designed to suit the demand of occupants and spaces. Mechanical cooling and heating systems are to be limited to permanently occupied zones. There will be limited spot cooling and heating required to office areas and informal meeting areas within the crevasse. This will reduce the overall electricity demand and energy consumption of the building.

It is proposed that the building's chilled water needs be served by high efficiency water cooled electric chiller and absorption chillers fed by waste heat from gas generators. There is also an option to use top-up cooling from the main campus chiller plant instead of using electric chillers. Gas fired boilers are to provide boost and/or back up heat input for the absorption chillers and for winter heating. These boilers could be replaced with either absorption chillers with direct fired gas backup or to use top-up heating from the main campus chiller plant. Variable speed pumps and fans are proposed to be used where appropriate. Cooling towers with variable speed fans are proposed for heat rejection. Further design development will be required to determine which of the cooling and heating options is optimal for this building.

The building HVAC system is currently proposed to be a mixture of Air Handling Units (AHUs), Fan Coil Units (FCUs), overhead and underfloor supply for the basement levels and Level 1 and a floor displacement system on Levels 2 – 12. There will be a combination of floor by floor and central AHUs to serve the conditioned spaces within the building.

The centre and perimeter zones will cater for the solar gain and heat transmission effects experienced through the façade. It is proposed that each lecture theatre, each separate laboratory and teaching/lecture space be separately zoned and automatically isolated when not in use to minimise energy waste.

New Spaces that offer Natural Daylighting

Natural daylighting within a building offers improvement to the internal environment of a building and can result in reductions in energy consumption associated with artificial lighting. The design incorporates internal atrium along the majority of the length of the building which separates the north and south wings of the building. A roof light also runs along the crevasse to provide natural daylight to this area. The crevasse will promote natural daylighting to these spaces and reduce artificial lighting during daylight hours. This feature aids in improving indoor comfort of occupants and provides a communal space for students to enjoy.

Lighting Specification and Design

Lighting efficiency is important in maintaining low energy consumption for reuse projects. Lighting consumption for a facility such as the Broadway Building could account for between 25-40% of the estimated energy use of the building. To satisfy these requirements all teaching spaces, offices and speciality areas are to be fitted with efficient fixtures (minimum T5 fluorescent) to reduce the ongoing energy consumption. Reduced lighting densities are to be targeted for the relevant spaces (where appropriate) to improve energy efficiency in operation. The project team is working to achieve desired natural daylight levels to the interior communal spaces within the atrium to reduce general lighting densities.

Automated Lighting Control System for Functional Spaces

Lighting controls (time switches and dimmers) allow lights to be turned off when areas are unoccupied or when natural daylighting provides sufficient light to the space. Automated lighting controls are to be adopted for the building to switch off when spaces are unoccupied. This will ensure that no interior lights are operating when not required. Lighting controls will be zoned to a maximum of 500m^2, or each functional space (whichever is lesser), so that the areas can be lit according to needs of occupants and building management requirements.

Daylighting sensors to the perimeter zones of the building are to be incorporated to allow lights to allow automatic dimming or switching off (as appropriate to maintain lux levels) when there is adequate daylight. Motion sensors are proposed for back-of-house areas and plants spaces with manual overrides will be provided to all areas to ensure safety.

Monitoring & reporting

The use of sub-metering to record and measure the electricity consumption of different energy uses within the facility is to be integrated into the Building Management System (BMS). Electrical meters are to be provided to monitor both light and power consumptions separately for primary functional areas per floor. These include classrooms/lecture areas, tutorial spaces, auditoriums, office and laboratory spaces. Functional spaces are to be grouped together and monitored where the combined area does not exceed 1000m^2.

Metering will allow the facility manager to monitor energy usage attributed to the different spaces such as major plant & equipment, functional spaces (as required) building floors or zones. Ongoing reporting allows the University facility management to set goals for energy consumption reductions and attributed energy costs to particular uses. By monitoring energy, losses and wastage can be

identified, therefore improving the overall performance of the building in operation. This initiative is subject to further design development and review.

The building will incorporate a digital display within the main foyer that will display to students, staff and visitors the energy consumption of the facility in real time. Electricity meters are to be installed into main classrooms or functional areas that demonstrate the impact of electricity usage during different times of year and day.

Internal Stairs

Internal stair systems have been located within the main atrium (crevasse) space to promote travel between floors in a socially conscious manner and reduce the reliance on energy consuming travel means such as vertical transportation systems. The stairs have been designed to be highly visible to occupants and within 20m of the building entrances.

Education Infrastructure Fund

As part of the learning objectives of this building, along with the sustainability targets, there are a number of initiatives that have been proposed that are designed to showcase certain technologies which are part of the Education Infrastructure Fund (EIF). There are three renewable energy generation technologies that will be installed on the roof of the Broadway Building to both generate energy and serve as educational demonstration systems.

A vertical axis wind turbine is to be installed on the roof. Although field data has shown that micro wind turbines of this size located in urban environments do not generate meaningful amounts of electricity, it will serve as an excellent example of a working wind turbine system for engineering students.

There is also a solar trough hot water system, which uses parabolic mirrors to heat water, which can be used for domestic hot water in the building.

A photovoltaic array will also generate electricity for the building and will be located on the roof to serve as both electricity generator and educational tool.

Water Efficiency

The following water efficiency measures have been proposed for the project which satisfies The UTS key Sustainability Policy requirements and Director General Requirements for Water efficiency:

- Implement water conservation measures
- Reduce stormwater runoff / output from the site; and
- Adopt efficient landscape irrigation systems

On-site recovery & reuse

Rainwater is to be harvested from the main roof structure of the building, as well as from the covered laneway between Building 10 and the Broadway Building, and will be distributed to serve WCs, urinals, cooling towers and any site irrigation. A 50kL – 100kL rainwater tank (or similar capacity) is proposed for the building and is currently located in the roof plant system. The tank has been sized based on expected roof capture area.

Specification of Fixtures & Potable Water consumption from Laboratories

Potable water usage for the site will be attributed to cooling towers, fire systems, water closets, urinals, basins, showers, kitchen sinks and some external works for landscape irrigation. To reduce the overall demand attributed from these uses, fixtures are to be specified to achieve a minimum 6 WELS rating where feasible for the proposed use.

The specification of the laboratory fixtures are to be meet minimum code requirements in lieu of water efficiency fixture specifications to ensure that they are fit for purpose. To reduce the potable water consumption from the laboratories, at least 95% of the water requirement for all once-through water is to be sourced from non-potable water sources. This initiative is subject to design development.

Water Meters

Water meters are proposed to be installed to all major water uses within the building which includes:

- Cooling towers
- Potable water consumption to bathrooms
- Landscape irrigation systems
- Rainwater supply to track water savings
- Fire systems and test recovery systems
- Hot water supply
- Laboratories

Meters are to be linked to the building management system that is to be linked to the site-wide University management systems. All meters are to be fitted with leak detection systems to ensure that there is a facility to ensure that leaks can be identified and rectified on site when they occur.

Landscape irrigation systems

All landscaping to the site is to be served by an efficient low water demand system that includes moisture control systems and sensors to reduce water consumption for landscaping. Rain water is to

be captured and harvested from the roof and other site hard surfaces for use on the landscaping to reduce potable water consumption attributed to site landscaping by 90%. A rainwater storage tank has been designated within the roof plant area and is to have a capacity of 50kL – 100kL

3.3 Waste Management

The following management initiatives have been proposed for the project which satisfies The UTS key Sustainability Policy requirements and Director General Requirements for Waste Management during construction:

- Environmental Management Plans are to be developed to NSW Guidelines for the demolition and construction phases of the project
- Waste Management Plan to manage the volume of waste sent to landfill. The project will be targeting minimum 80% of diversion of waste from landfill throughout the construction stage of the project

All plans are to be prepared by the head contractor in association with relevant consultants to ensure the appropriate management of services and hazards within the building during delivery and operation.

Environmental Management Plan

A project specific Environmental Management Plan (EMP) is to be developed demonstrating compliance with the requirements of Section 4 of the NSW Environmental Management System Guidelines 1998. The head Contractor for the development is to be accredited to ISO 14001 certification for the company's EMS systems and hold this accreditation prior to project commencement. All Contractor personnel and Subcontractors are to adhere to this EMP for all works and the Contractor is to demonstrate this on completion of the project. The Environmental Management Plan for the development is to cover site management techniques for waste recycling, hazardous disposal, education and training, health & safety aspects and action plan for site construction targets.

Waste Management Plan

A Waste Management Plan is to be prepared to ensure that a minimum of 80% (by mass) of all demolition and construction waste from the site is re-used or recycled. The contractor is to dedicate a portion of the site to management and sorting of construction wastes as appropriate. The wastes that are expected to be recycled for reuse / reconditioning on the project include, but are not limited to:

- Bricks and blockwork
- Concrete
- Tiles
- Timber products
- Plasterboard
- Steel
- Aluminium
- Insulation products
- Carpets
- Ceiling tiles
- Light fixtures and fittings
- External landscaping – pavers
- Green wastes
- Plastics / PVC
- Pallets
- Cardboard

Quarterly waste reports are to be submitted by Contractor to track the production and management of wastes on the site. This will ensure that the project will measure the extent of wastes produced and minimise the production of wastes where appropriate.

Operational Waste Management

As part of the UTS Design Guidelines and the ESD Masterplan UTS have a number of campus wide waste reduction and disposal services. As part of this service UTS aims to:

- Avoid unnecessary consumption
- Reduce and manage demand
- Reuse what we can on campus and donate or sell the balance
- Recycle as much as we can when we do dispose
- Dispose of any non-recyclable and hazardous waste in a responsible manner

The waste on campus is comingled on site (all waste is disposed of in the same bins) and then is transferred off-site to a materials recovery facility where it is sorted for recycling. At this facility, paper is separated out first, then glass, metal and plastic is separated out by hand for resale to recycling companies. Waste which cannot be recycled is sent to a bioreactor, which produces methane gas for gas-fired electricity generators.

UTS also recycles a wide range of office related waste including mobile phones, toner cartridges, computers, fluorescent tubes, furniture and expanded polystyrene.

3.4 Management

The following management initiatives have been proposed for the project which satisfies The UTS key Sustainability Policy requirements and Director General Requirements for Operational Management:

- Building Users Guide
- Building Maintenance Guide
- Comprehensive commissioning process

Building Users Guide

A simple Building Users Guide is to be developed for the project to provide Facilities Management (building manager) with the details of the building that outline ideal operational and maintenance procedures. The document will include:

- Energy and Environmental Strategy
- Monitoring and Targeting
- Building Services
- Transport Facilities
- Materials management
- Waste management
- Expansions and refit considerations including staging considerations

The Guide is to be produced in association with all consultants on the project and will be reviewed by UTS Facilities Management staff throughout the relevant stages of the project to ensure that the approach is reasonable.

Building Maintenance Guide

A Building Maintenance Guide is to be prepared for the project that describes the measures that are to be undertaken to maintain and ensure that the building operates as designed and in the most efficient manner. The guide is to be submitted to appropriately trained University staff (Facilities Management staff) for their review and comment throughout the design development stage of the project. The guide is to include the following details on the building:

- General overview of the spaces, areas and expected occupancy figures
- General overview of the unique features of the building
- Recommendations relating to environmental maintenance of the building initiatives that relate to energy, water and materials efficiency
- Environmental and Health Mission Statement
- Detailed guidance on access and maintenance for the relevant building details:
  - External building fabric
  - Mechanical services
  - Electrical services
  - Hydraulic services
  - HVAC systems
  - Lighting systems
  - Operable windows
  - Heating control

The purpose of this document is to provide future building management with the necessary understanding of the building features and systems that will facilitate education and input from UTS staff.

Commissioning

The project will undertake a comprehensive commissioning strategy for the building that includes pre-commissioning, detailed commissioning, post-commissioning reviews by all of the relevant Contractors. Commissioning is to be completed in accordance with relevant CIBSE and ASHARE codes where relevant to the proposed services works. As part of the commissioning strategy an independent consultant is to be engaged to review the results throughout the staged delivery of the works. All testing data is to be consolidated into a report for review by UTS Facilities Management staff and integration into the Building Users' Guide and Building Maintenance Guide.

3.5 Transportation

The following transportation initiatives have been proposed for the project which satisfies The UTS key Sustainability Policy requirements and Director General Requirements for providing Alternative Transportation options for the site:

- Small car spaces and preferred parking for these spaces
- Cyclist facilities
- Access and connection to public transport networks
- Building Users' Guide that promote alternative transport options to building staff

Small Car Spaces

Small car spaces are to be provided within the building for 25% of total car spaces. These spaces are to be located throughout the four level basement car parking. By providing small spaces within the building it is expected that this will promote staff to adopt small cars for their personal use and result in a reduction in associated reduce greenhouse gas emissions. To promote car sharing and reduced personal vehicles movements to and from the site, 10% of total car spaces are to be designated to carpooling vehicles in preferred parking positions. Preferred parking spaces are those located closest to the facility main entrance or lift services.

The University is to promote these initiatives throughout building staff through the use of internal notifications / publications and building user's guide. Car parking signage is to be posted to the relevant spaces designating the spaces as small car spaces and preferred parking spaces. Small car spaces are to be designed in accordance with relevant Australian standards and codes to ensure that the spaces cannot be converted to normal car park bays.

Conduits are to be included in the car parking area to allow the installation of recharge points for hybrid/electric vehicles.

Cyclist Facilities

Cyclist facilities are currently planned to be provided within Building 10 to provide staff and students with alternative modes of travel that reduce the overall greenhouse gas emissions of the site in operation. Cyclist facilities include 250 secure bicycle racks for staff and students of the Broadway Building. The appropriate amount of showering and changing facilities will be provided in close vicinity to the cycle storage area.

Access and Connection to Public Transport Networks

The building is located within Sydney city metropolitan area that is within close proximity to main public transport networks along Broadway. The site has direct access to Broadway and public access through other areas of the campus that leads to other transport connections. The access to Broadway links the site to bus networks that connect to Central Station, City Centre and Western Connections.

3.6 Green Star Rating

Green Star is an environmental design rating tool that has been tailored for the Australian climate and environmental issues. The tool was developed based on LEED and BREEAM International tools. The tool focuses on a range of elements that encompasses leading design in energy and water efficiency, materials, emissions, transport systems, management and indoor environment. Operational since 2002, the tool has been tailored to cover many different building types, including office refurbishments.

The Green Star Education tool has been developed for educational University facilities for new and refurbished buildings. The project is targeting a Green Star 5 star rating and the scorecard is detailed in the following sections of this document.

3.7 Green Star Points Schedule

Based on the Sustainable Design initiatives as described in Section 3 of this report, the following Green Star Education v1 target has been set for the project across the relevant categories to achieve 5 star project commitment target:

Category	Points Available	Points Targeted
Management	14	14
IEQ	25	18
Energy	29	14
Transport	13	11
Water	16	11
Materials	27	15
Ecology	5	4
Emissions	14	8
Total	**148**	**95**
Weighted Points	**100**	**69**
Equivalent Green Star Rating		**5 stars**

A project needs to score a minimum of 60 weighted points to achieve a 5 star Green Star rating.

Sustainability Measures

To manage the consumption for resources associated with the development sustainability measures have been identified estimate, set goals to minimise, mitigate and avoid consumption where possible. The measures relate to energy, water, materials, building wastes (sewer & occupant) and individual occupant impacts of movements.

The following table indicates the measures that the project team are to implement to measure the environmental savings for the development.

Resource	Measure	Method for Tracking Usage	Measures to Minimise / Mitigate
Energy	$kgCO_2$-e per annum (GHG) kWh per annum	Electrical meters & sub-meters for different plant, equipment & spaces	Natural ventilated spaces High performance façade systems Efficient plant & equipment Efficient fixtures
Water	ML per annum L per person per day	Water meters for all major water uses	Rainwater harvesting & reuse Stormwater management on site Reduced flow ratings on fittings
Materials	Embodied energies Embodied water	Lifecycle assessments on material quantities consumed in construction	Materials supplements with waste materials Recycling and reuse of materials
Building / Site Wastes	T Wastes per week ML per annum	Waste receipts Stormwater capture	Recycling facilities on site Stormwater reuse within the building
People Movements	$kgCO_2$-e per annum (GHG)	Surveys of staff and usage rates of alternative modes of transport	Cyclist facilities Public transport access