IDS12 – Unanderra Police Station Redevelopment

Illawarra Local Aboriginal Land Council (ILALC)

Vetting Report 2nd May 2022

Image: Student 9 Assignment Submission, IDS12

Document Verification

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The report presented is a collaborative effort of the above noted authors.

Overview

The iHub Integrated Design Studio (IDS) ran during the second semester of 2021 and included Engineering major students from the University of Wollongong supported by the engineering faculty and consultants from industry.

In this studio, the students investigated sustainable design options for the redevelopment of the Unanderra Police Station building for the Illawarra Local Aboriginal Land Council. This study investigated ways to improve the performance and sustainability of two proposed designs for the ILALC, with the intention to reach a net zero energy goal. The two designs were for an existing building (old police station) and a new mixed-use building - both to be located in Unanderra, NSW Australia

This summary report documents the vetting process undertaken by the supporting consultants following the completion of the studio. The aim of this report is to summarise the process of the IDS and capture the key recommendations developed by the students, faculty, and consultants over the course of the semester.

Existing

Image: Group 1 Assignment Submission, IDS12

Proposed

Image: Student 9 Assignment Submission, IDS12

Introduction

I-Hub is a program run by the Australian Institute of Refrigeration, Air Conditioning and Heating (AIRAH) alongside the University of Wollongong and supported by the Australian Renewable Energy Agency (ARENA). It aims to facilitate the HVAC industry's transition to a low emissions future, stimulate jobs growth and showcase HVAC innovation within buildings.

The Integrated Design Studios are a part of this initiative and explore innovative solutions for achieving net-zero carbon on complex design projects.

University of Wollongong students in the IDS12 design studio were given the task of designing a sustainable, net-zero, redevelopment for a Local Aboriginal Land Council facility at the existing Police Station building at Unanderra. A range of feasible opportunities for minimising the project carbon footprint and energy usage were to be considered including active and passive solutions. This had the overall target of achieving a Renewable Energy Fraction (REF) of 1.0 to demonstrate net zero.

Weekly studios were held over the semester, supported by the engineering faculty and industry consultants from Edmiston Jones Architects, Northrop, E-Lab Consulting and MIEngineers.

Net-Zero Carbon

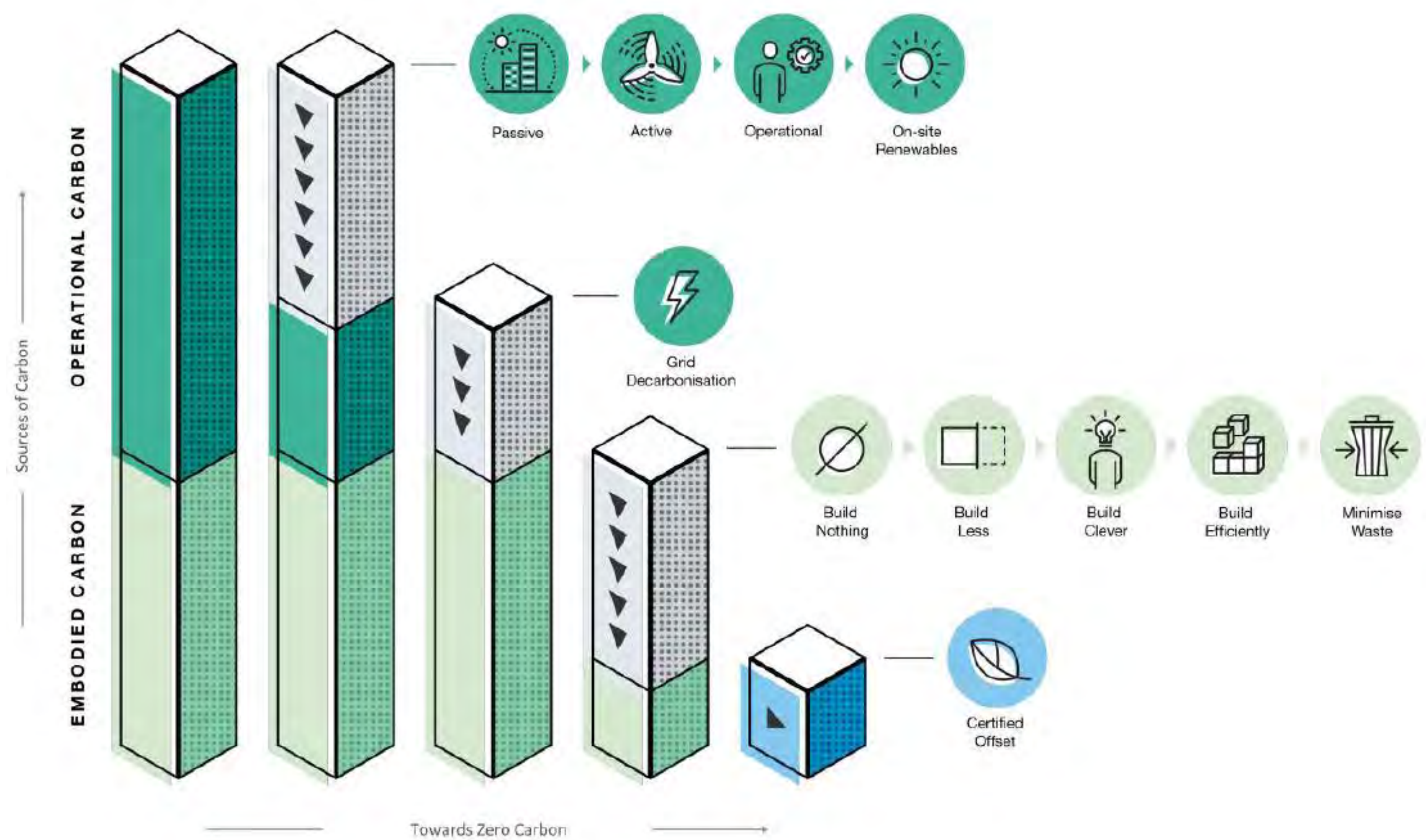
This term is commonly used across industry but its definition varies due to a lack of consensus on where the boundary for assessment is defined for a given building.

For the purposes of this studio, the term 'net-zero carbon' encapsulates both the operational carbon emissions and embodied carbon emissions.

Operational carbon emissions are those that are generated over the service life of the building.

Embodied carbon typically refers to carbon emissions generated by the construction, maintenance and demolition of the building with a particular focus on the construction phase as the most understood and quantifiable metric.

A truly net-zero building considers the whole lifecycle, with the emissions associated with building materials, construction, operation, and end of life all quantified and accounted for. Thus any emissions generated by embodied carbon during to construction must ultimately be offset during the operation of the building to achieve an overall net-zero.



Source: Arup - net-zero carbon buildings: three steps to take now (2020)

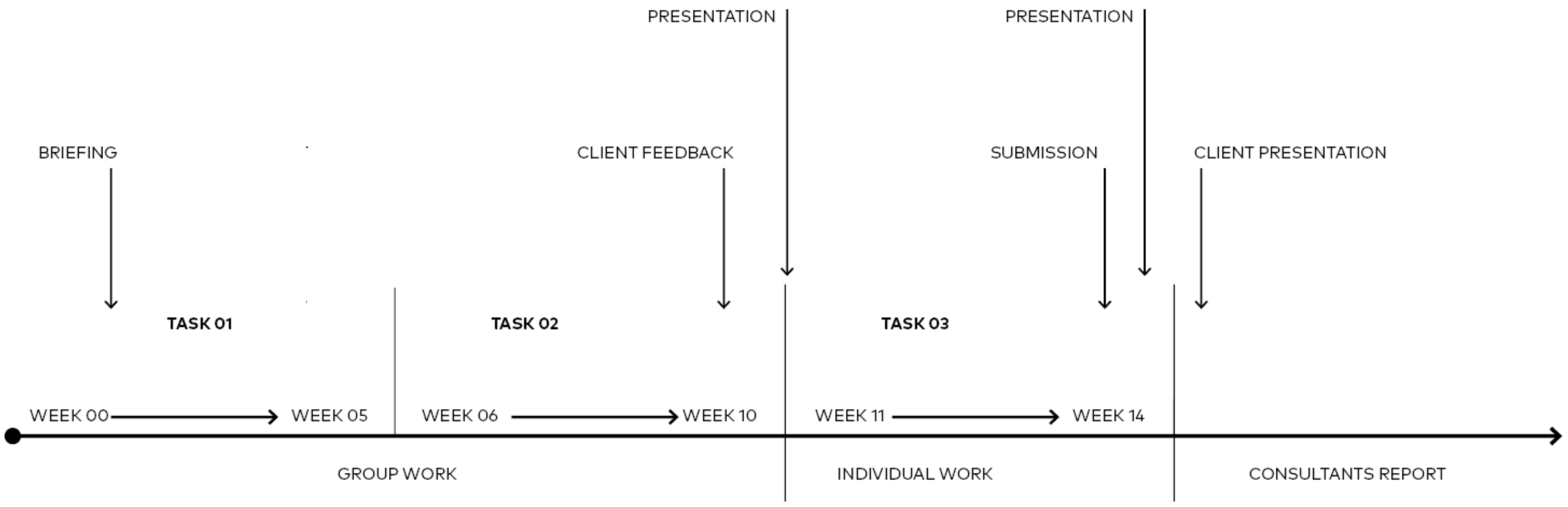
Studio Structure

The students met weekly throughout the semester to workshop and discuss ideas with the engineering faculty and industry consultants.

In the first few weeks, students were provided with a written design brief and video conference with Mr. Paul Knight from the Illawarra Local Aboriginal Land Council to direct the avenue of inquiry. A previous design option had been developed by Merribi Group and was presented as an example of options for usage of these spaces.

Following this, a range of initiatives were developed in the form of a return brief and site analysis. The initiative were subsequently assessed in a detailed matrix which included feasibility, cost, constructability, and a number of other criteria. These options were refined over the course of the semester to identify key changes that would have the most impact towards moving the building to net-zero.

The studio was structured around three assessment tasks where students presented their written submissions to the class and the clients. The first two tasks were developed in groups that required collaboration between a 'design team' of students from different engineering majors. For the final assessment, each student selected one or two key initiatives to research in more detail and explore with computer modelling and analysis of building performance.



Studio Interactions

IDS12 was undertaken during a period of intermittent lockdowns due to the COVID-19 global pandemic. Consequently, the studio sessions were conducted in online environments rather than the typical face-to-face interactions preferred for these collaborative exercises.

Weekly *Zoom* sessions with breakout rooms were used to facilitate the interactions between students, the faculty, and consultant. Assessment presentations were also delivered through this platform.

A number of online collaboration tools supported the development of the designs. The university's *Moodle* platform provided a central location for shared studio information and resources. The online collaboration tool, *Miro*, was used during studio sessions to provide a communal, collaborative digital whiteboard for sharing text, images, and ideas in real-time.

Image: UoW Moodle Platform for IDS12

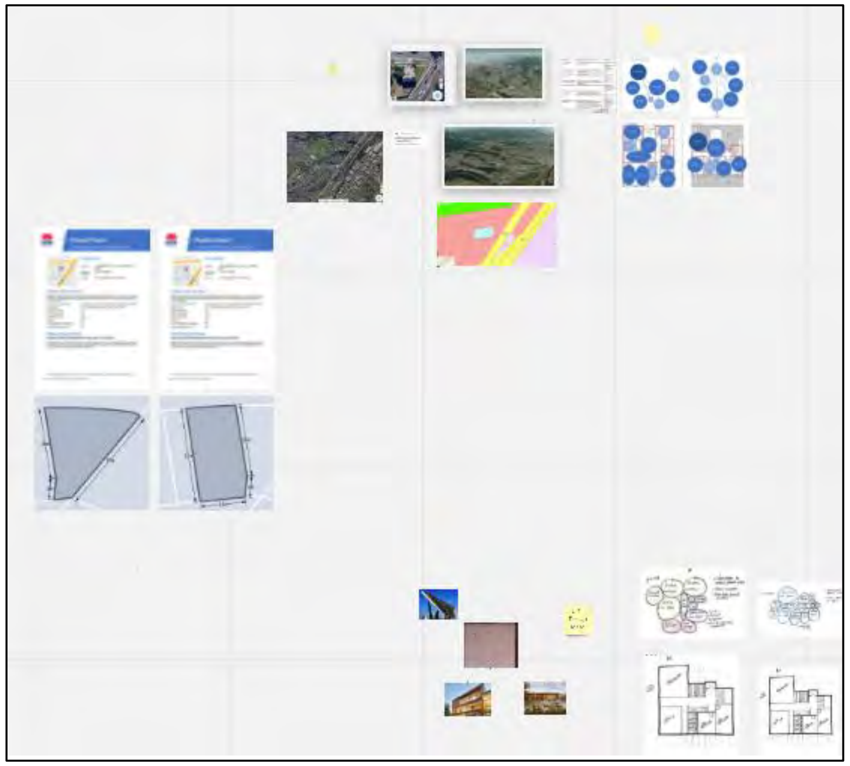


Image: Miro online collaboration environment from IDS12

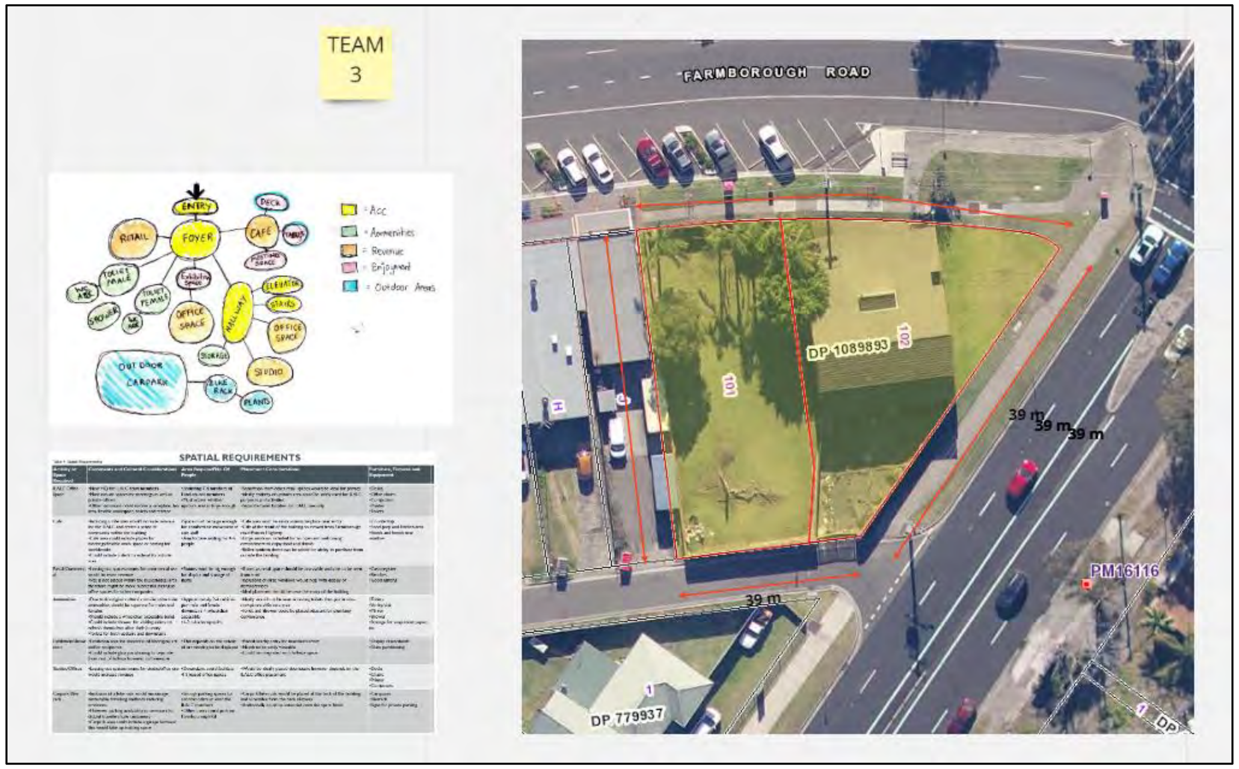


Image: Miro online collaboration environment from IDS12

Introduction

Location and Site

The site is located in Unanderra, NSW on the corner of Farmborough Road and the Princes Highway. The building is currently owned by Wollongong City Council who have presented this location as an option to ILALC for redevelopment.

The site occupies a central position in the suburb with good access to the main business areas in Unanderra good links to both bus and train public transport

The former police station building is a two-story, brick structure with a pitched tiled roof. The building structure is in reasonable condition and appropriate for reuse, however, a refurbishment of the internal space is required for the new usage. The building was recently damaged in a fire on 8 Feb, 2022 and thus requires a full upgrade.

The site also includes a vacant block to the West which was also considered as available to the redevelopment.

Image: Group 1 Assignment Submission, IDS12

Image: Dr Steve Burrows Foundation

The Climate

A review of the local climactic conditions was undertaken. This appreciation for weather and climate effects is a key component in developing holistic sustainable design solutions appropriate for a given location.

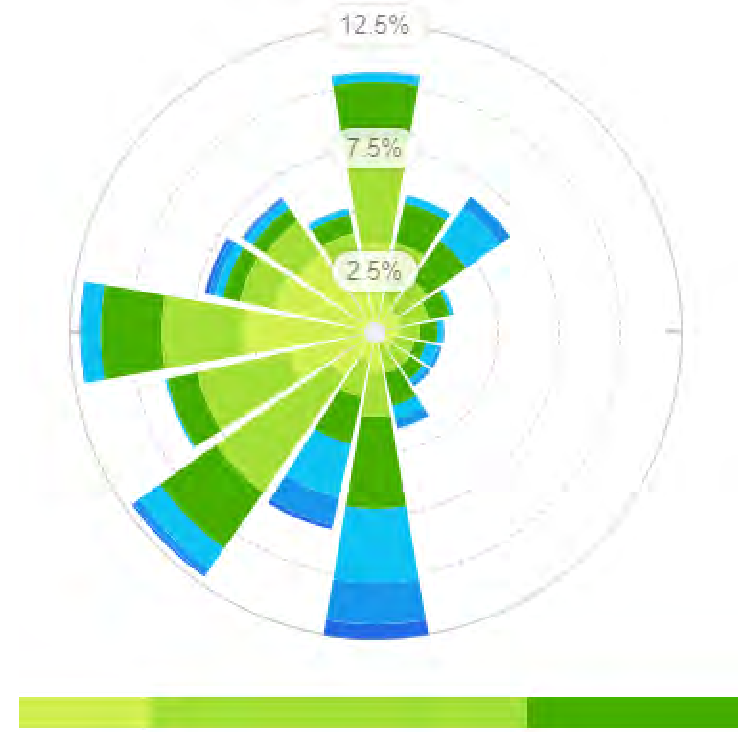
Unanderra categorised as a 'Zone 5' climate to the building code which is described as oceanic and typically warm with a significant amount of rainfall.

Average high temperature of 25.7°, with January being the warmest month and an average low temperature of 19°C with July being the coldest month. The average humidity is 75% (February being the most humid month) with a UV-index reading of 4. January and December however have an average of 6 UV indexes, being the months with the highest index. November has the most sunshine within a year with an average of 9.8hours while June has the least sunshine with an average of 5.9hours.

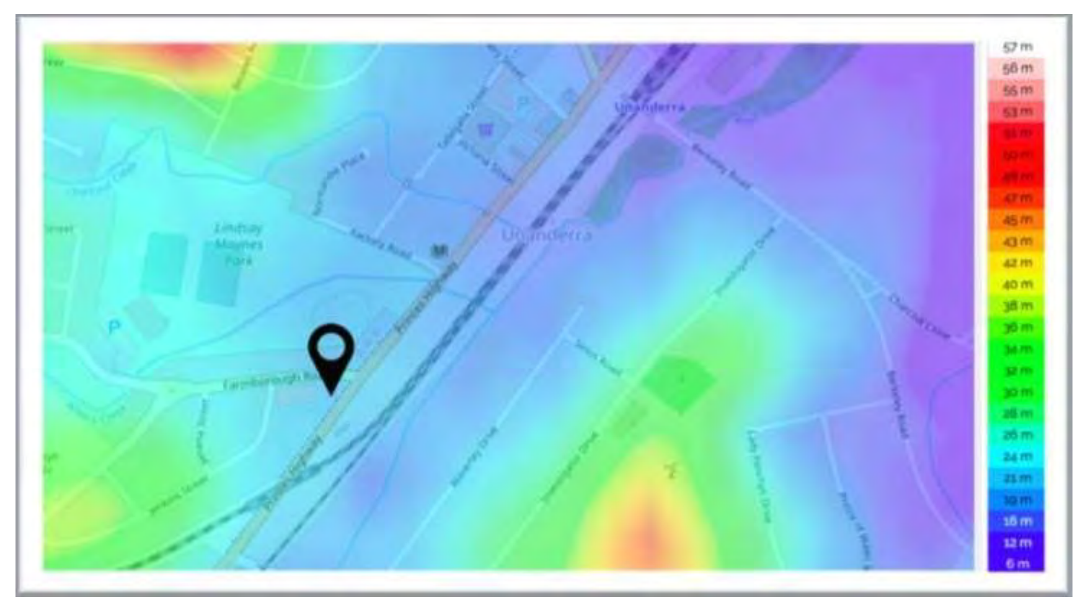
Throughout the year, there are approximately 170 rainfall days with a total of 678mm of precipitation over this period. The windiest month is August with an average wind speed of 16.2km/h. This is in comparison to April which is considered the calmest month with the lowest average wind speed being 13.9km/h.

The most predominant wind direction is from the South-West.

Solar Paths
Source: Group 3 Assignment, IDS12



Wind Mapping
Source: Group 3 Assignment, IDS12



Topology Mapping
Source: Group 3 Assignment, IDS12

Integrated Design Studio

Through the IDS process, the students and tutors worked to explore alternate design elements and positive actions that could be taken to improve the current performance and help the building move towards net-zero carbon in operation.

Students would propose options for sustainable measures for the redevelopment of the police station and together teams would assess the viability of these options in the context of the project.

These were tested through literature reviews, exploring the site-specific restraints and modelling the performance improvements in programs used in industry to assess thermal and overall energy performance.

The following pages show examples from students work where they have addressed the key tasks set out for them in the studio.

Images: Group 1 Assignment, IDS12

Images: Group 2 Assignment, IDS12

Image: Student 5 Assignment, IDS12

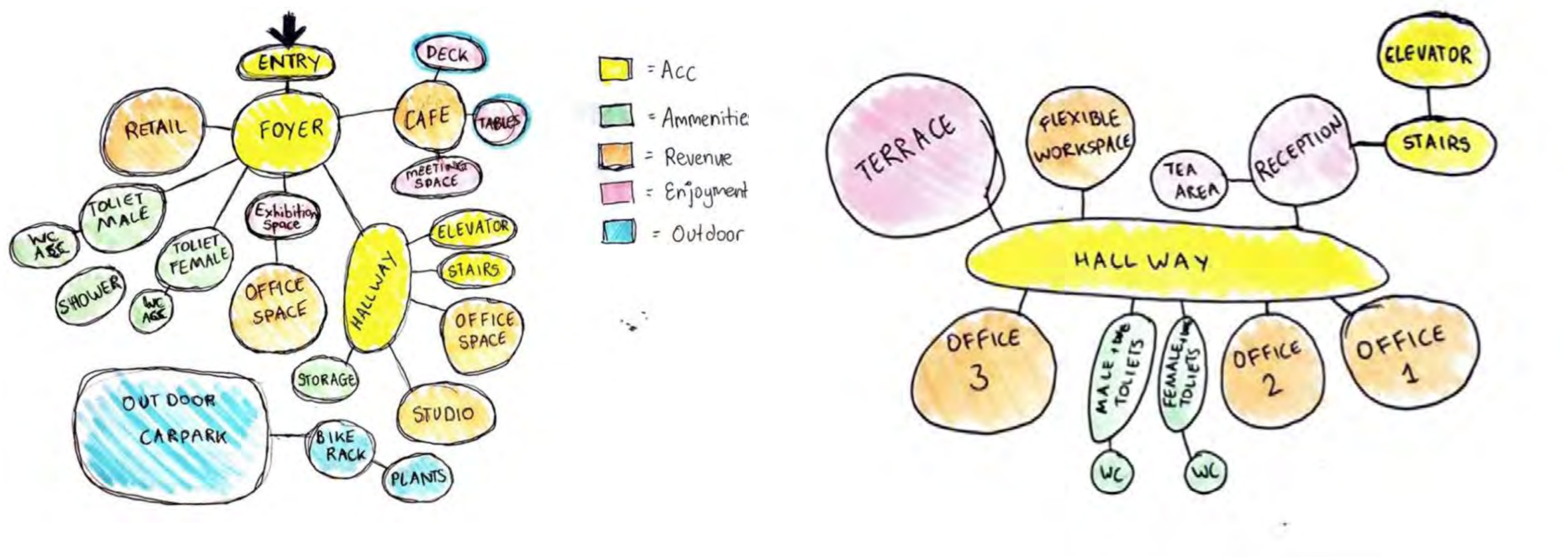
Task 1 Site Analysis and Return Brief

To better understand the building requirements, the students developed a site analysis and return brief. This brief detailed such items as; the existing condition of the building; the local environmental conditions; and end user requirements which would inform the direction of their investigation of sustainable initiatives.

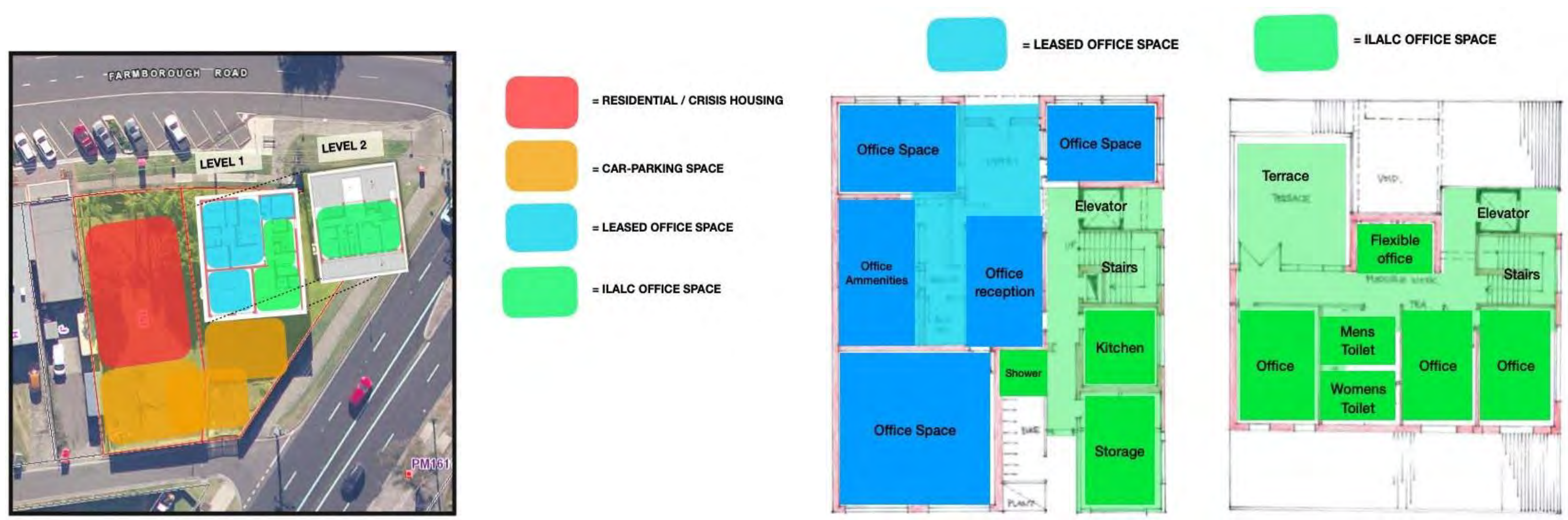
Bubble diagrams were developed to explore the connections between internal spaces and the possible options for usage.

In the initial brief, examples of the areas of consideration were:

- Natural features
- Indigenous heritage
- Heritage
- Transportation & connectivity
- Character of built environment
- Services – existing and new
- Climate/microclimate, solar access, predominant wind direction
- Constraints & opportunities



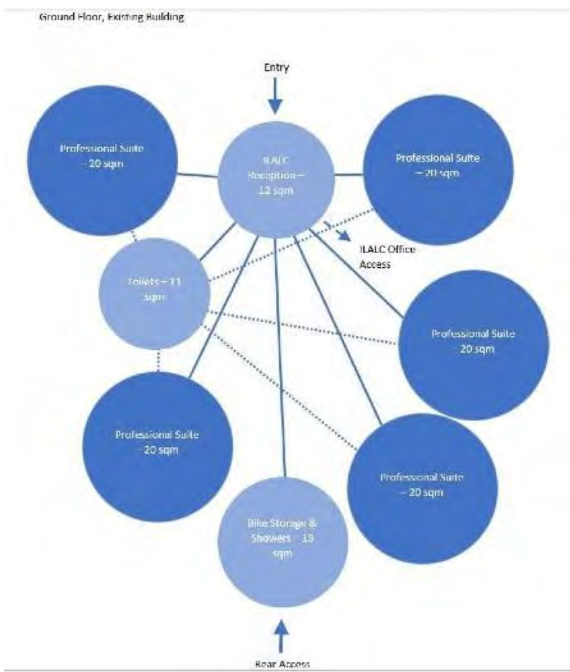
Images: Group Assignment, IDS12

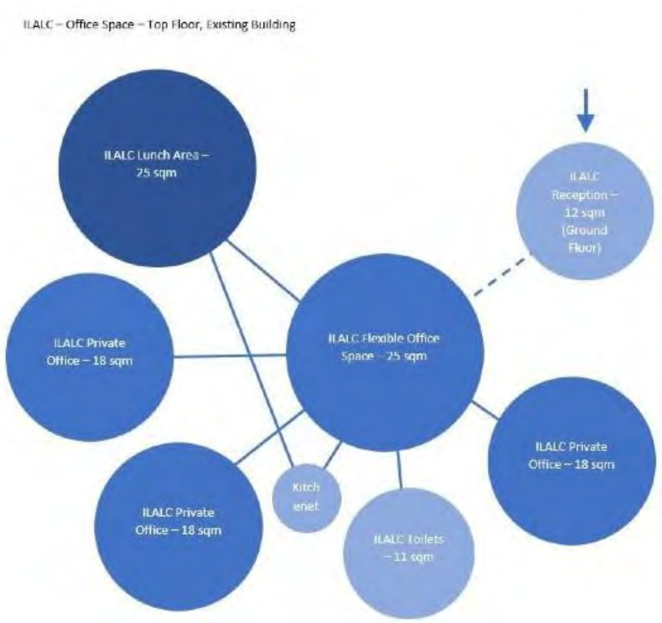


Images: Group 3 Assignment, IDS12

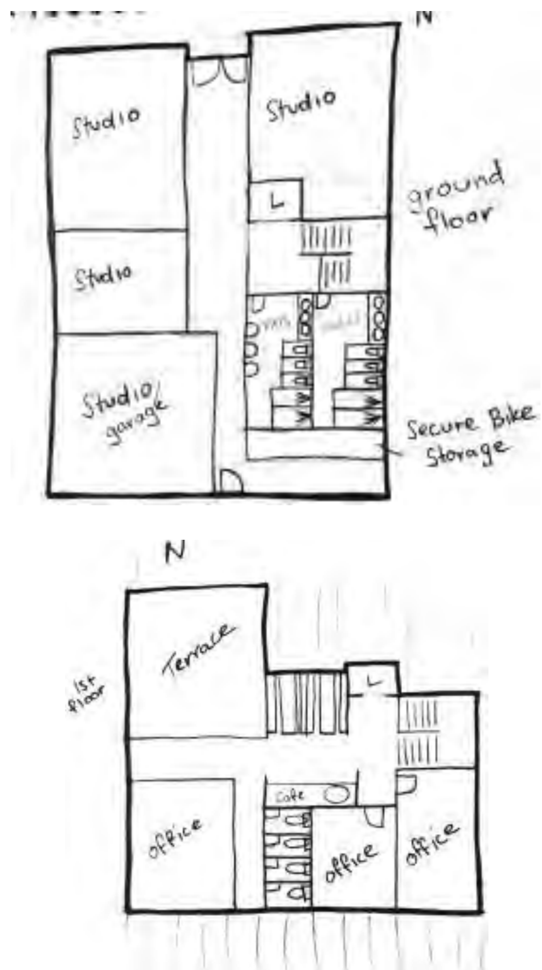
Studio

Task 1 Site Analysis and Return Brief

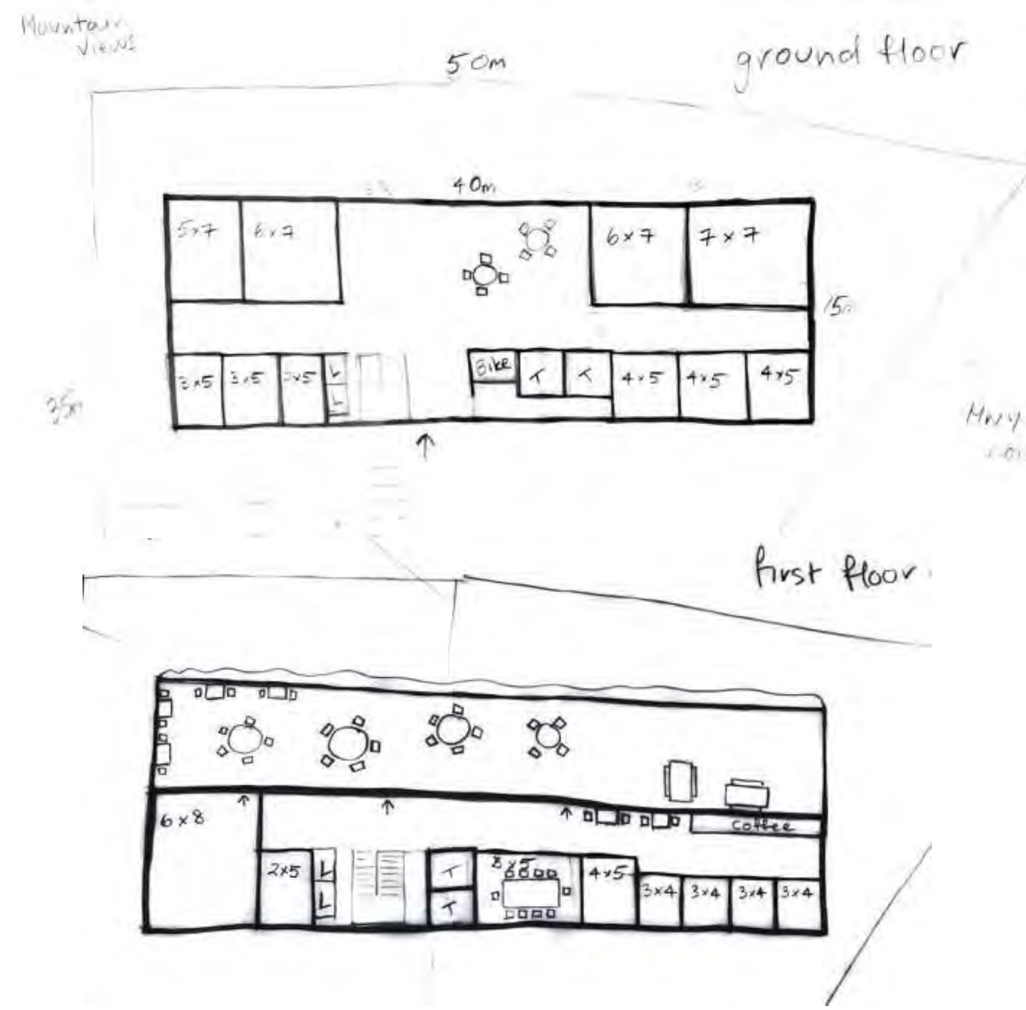




Images: Group 2 Assignment, IDS12



Images: Group 1 Assignment, IDS12



Task 2 Research

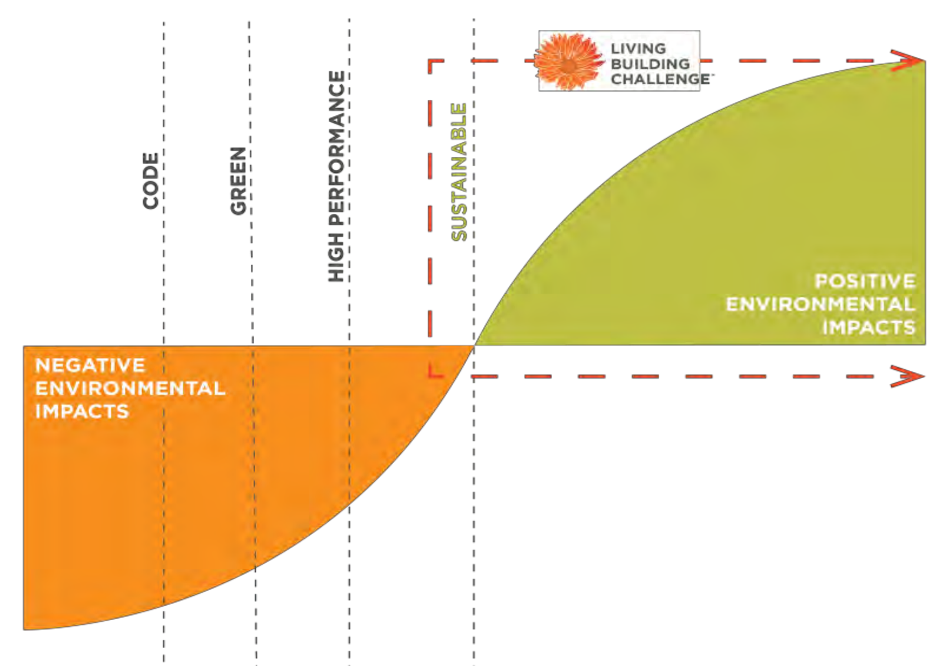
With the brief defined, and the facility details confirmed, the students reviewed technology and processes that might address any perceived any energy efficiency issues. These ideas were required to be specific to the site and the problem at hand. The solution had to work for the Unanderra site.

The students were encouraged to review critically each process and assess their potential contribution to the overall site goals.

Although focused on reduction in carbon intensity, students were also encouraged to review other potential benefits such as water efficiency and contribution to wellness. This led to benchmarking and borrowing ideas from a range of sustainability benchmark tools, including NABERS, Green Star, WELL and BASIX.

The students explored a range of technologies based on simple building improvements to mechanical system design and took inspiration from similar projects around the world.

Most students explored common and typical solutions to standard design problems.



During research, inspiration was taken from a range of sources including the UN Sustainable Development Goals and Living Building Challenge

Task 3 Proposals

Each student finally worked on assessing in detail their proposed initiatives. This included where appropriate energy modelling of the facility to identify the potential carbon saving benefit.

Students built Dynamic 3D models of the spaces, and tested each initiative to work towards improving the overall outcome.

The students final reports summarised the findings of their analysis and allowed them to provide their assessment of the achievable savings associated with specific technologies.

Some students were able to demonstrate a REF of >1 meaning the site was achieving net zero under modelled conditions.

Figure 32. North Elevation Improved Existing Building (NTS).

Figure 33. South Elevation Improved Existing Building (NTS).

Figure 34. West Elevation Improved Existing Building (NTS).

Figure 35. East Elevation Improved Existing Building (NTS).

Images: Student 1 Assignment 3, IDS12

Existing Building Improved (With Solar Generation)		
Total Solar Generation	45214.33 kWh	
Total Annual Net Energy Requirements	9344.907 kWh (Produces more solar energy than required)	
REF Values Hourly	No. Hrs	% Of Year
0	4197	47.91096
0<REF<0.30	620	7.077626
0.30<REF<0.95	1088	12.42009
0.95<REF<1.05	126	1.438356
REF>1.05	2729	31.15297
Annual REF Value	1.020174	

Table 3. Improved Existing Building Simulation Results.

Improved Existing Building Energy Breakdown		
	kWh	% Of Demand
Room (Equipment)	12382.15	34.52008
Lighting	10504.86	29.28638
Heating	340.8829	0.950344
Cooling	3881.528	10.82127
Hot Water	8760	24.42192

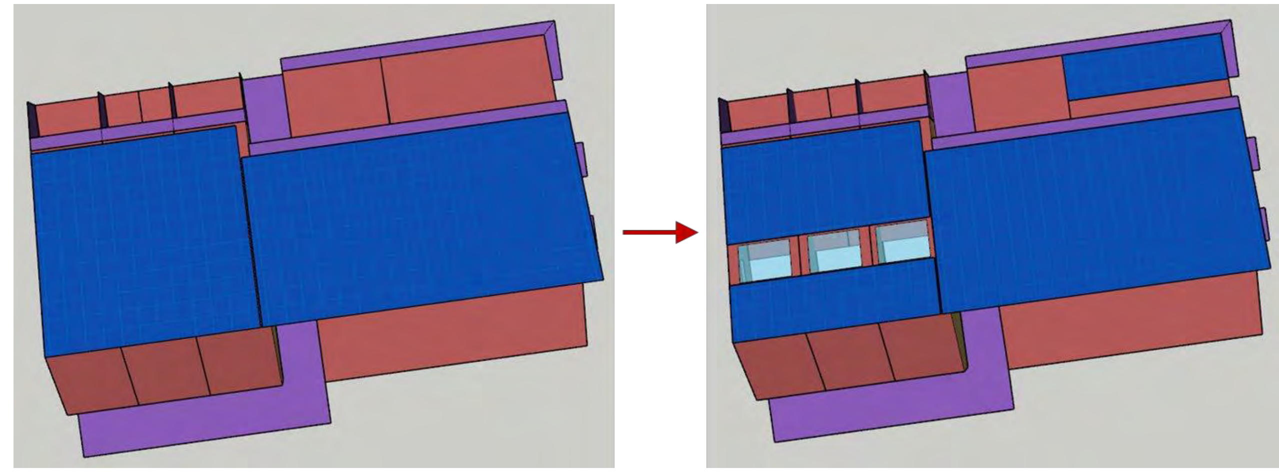
Table 4. Improved Exiting Building Energy Breakdown.

Images: Student 1 Assignment 3, IDS12

Studio

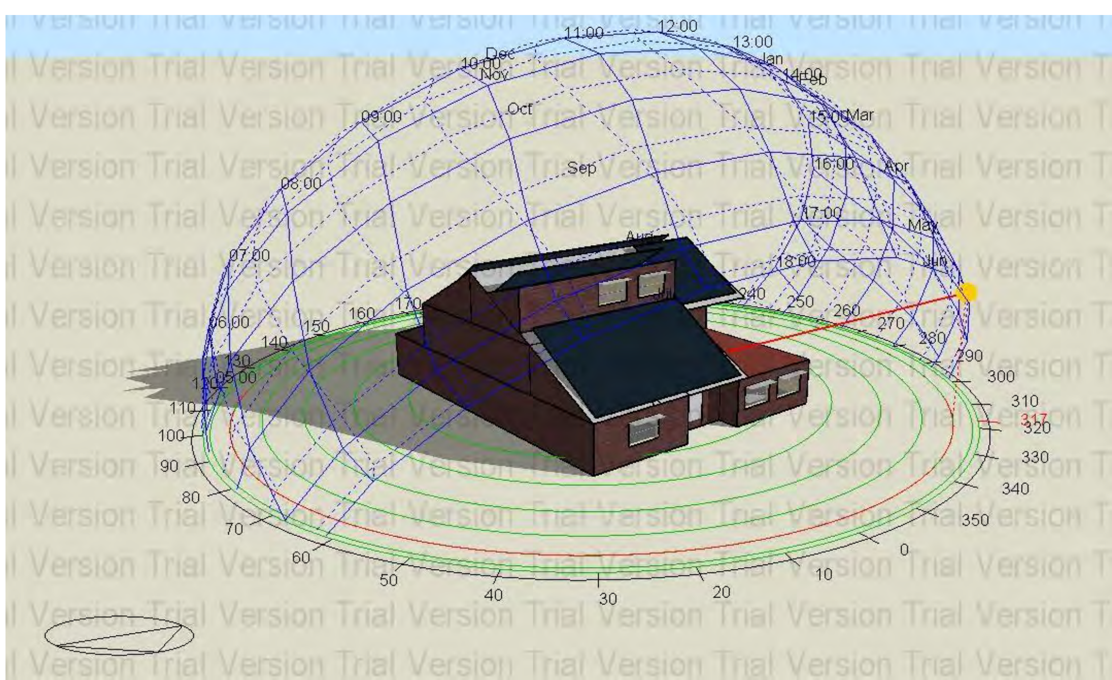
Task 3 Proposals

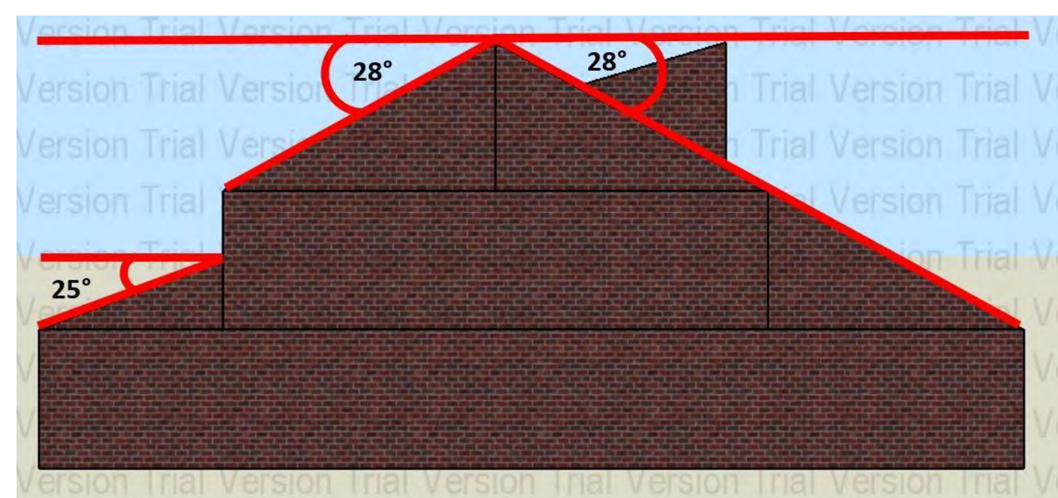
Further detailed information from a student's work is shown here including energy models, trying different orientations and assessing different PV arrays with the aim to maximise the overall performance outcome and improve the REF.



Case	Heating (GJ)	Cooling (GJ)	Lighting (GJ)	Equipment (GJ)	Total (GJ)	PV AC Output (GJ)	Site Net (GJ)	REF
Base	185.3	92.3	64.8	56.1	398.5	311.6	86.9	0.79
Insulation	167.3	86.6	64.8	56.1	374.8	311.6	63.3	0.79
Skylights	143.6	79.2	64.8	56.1	343.8	311.6	32.2	0.89

Images: Student 9 Assignment 3, IDS12 – Skylight and insulation assessment





Images: Student 7 assessed roof pitch as a design solution

Task 3 Proposals - Summary

Throughout the IDS, multiple ideas were presented by students. These were tested and modelled to calculate the overall improvements that were expected to be realised. The lists below highlight some of these ideas, as appropriate to the Lightning Ridge Development.

In line with the noted net-zero carbon approach noted previously, the features have been collected into categories and are reviewed as noted in the following section.

The key focus is applied to passive design techniques and opportunities

Student Ideas
(O) High efficiency HVAC systems
(O) Energy Recovery Ventilator
(P) Natural ventilation and mixed mode ventilation
(R) PV systems
(P) Using PV Systems as Shade
(I) Power Purchase Agreement
(P) Optimising the arrangement of Façade
(P) Double or triple glazed windows
(O) Data management and Advanced BMS
(P) Use of phase change materials (PCM)
(O) Thermal zoning (thermostat control)
(O) Indoor Breathing Wall
(O) Battery Storage for excess PV production
(P) Cool Roofs
(P) Shading
(P) Thermal mass
(P) Thermal Labrinth
(P) Solar Chimney w/ Earth Tube

Additional Ideas Explored
(O) Automated blinds
(O) Occupancy detection
(O) Daylight Dimming
(O) Relaxed setpoints
(O) Adaptive comfort through ceiling fans
(O) Native Planting below Solar Panels
(O) Centralised, efficient heating/cooling plant
(P) Improve quality of window/door seals beyond business as usual

Feature categorisation

(P) – Passive design

(O) – Operational efficiency

(R) – On-site renewables

(I) – Innovation/other

Energy Modelling

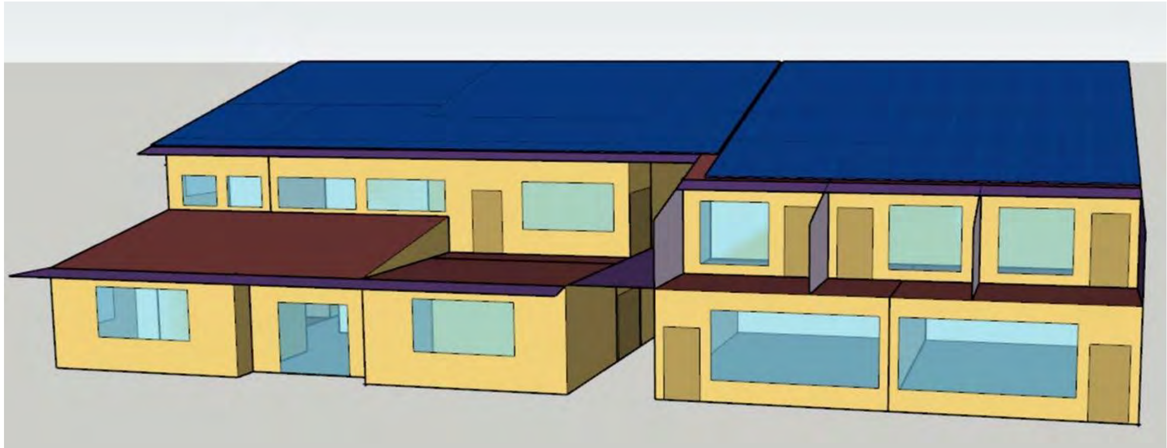
Energy models were developed by the students to assess their proposed improvements across the year. This design stage of verification allows the support of the development of the technology.

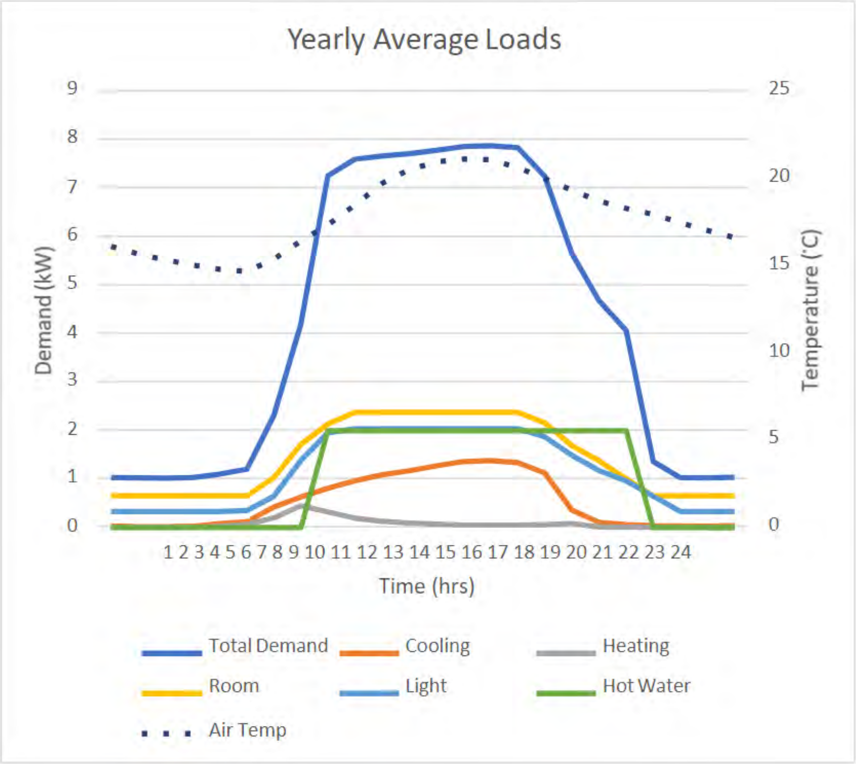
This was typically completed in either Google Sketchup and assessed using OpenStudio through the EnergyPlus energy modelling engine, or using DesignBuilder with their built-in engines which runs on EnergyPlus.

Students took on this task to develop the models themselves, but were guided by the Tutors and approached in a cross-discipline collaborative sense.

This allowed them to investigate how technologies could be applied and where the savings would come from. This is a critical step as it mimics how projects achieve this in a construction environment.

The common language used for all students was to achieve a Renewable Energy Fraction (REF) of >1.0 - indicating the overall development had achieved net-zero.





Passive Design

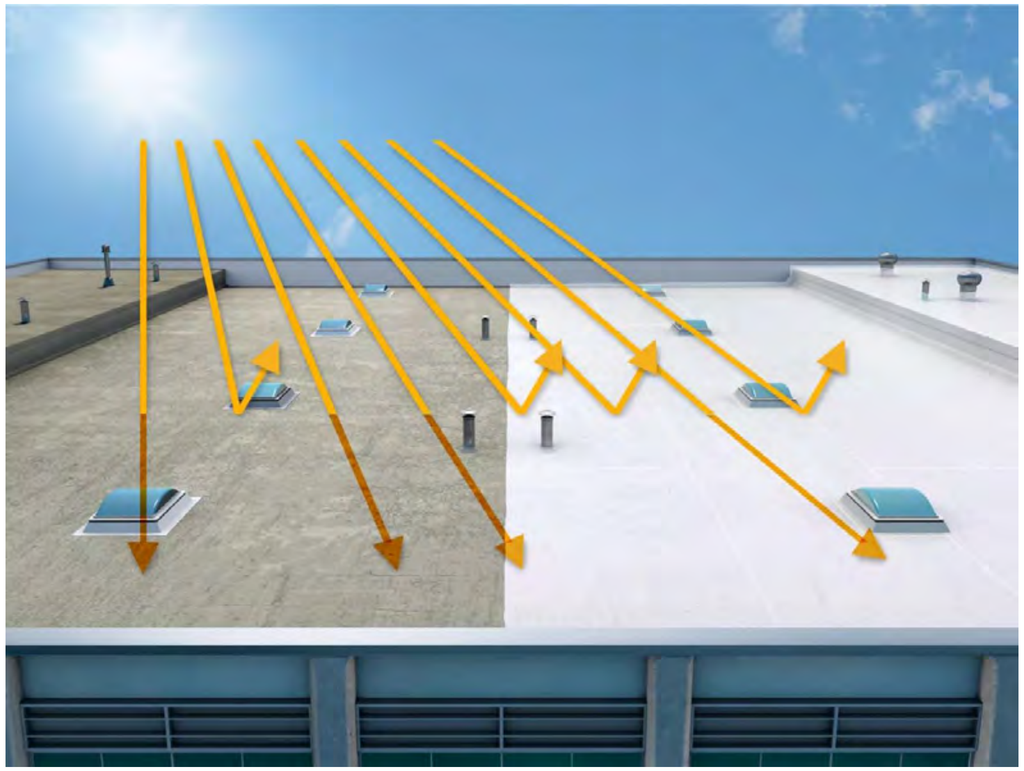
Students identified early on that there are significant opportunities to integrate passive design for new build designs.

Massing of the building can be adjusted to optimise solar load for both cooling and heating, which offsets the need for actives systems.

Students had a significant push on optimising the overall layout to minimise energy use. Students assessed several arrangements and passive elements to improve the overall performance, including:

- Window Arrangement
- Insulation performance
- Shading
- Air Tightness
- Passive Ventilation
- Window Performance and window treatments
- Cool roofs

Students typically found savings of up to 20% can be achieved through these passive methods while not impacting the building outcomes.



Cool Roofs reflect heat and significantly reduce heat loads in the space.
https://aus.sika.com/en/knowledge-hub/cool-roofs-and-energy-efficiency.html

Greenery below solar panels keeps the roof cool and can improve PV output by 4%.
https://www.pv-magazine-australia.com/2021/08/24/green-roof-improves-solar-panel-efficiency-by-3-6-on-average-peaking-at-16-study-finds/

Passive Design

Reducing loads passively was the key first step to achieving the reduction and assisting with the REF.

Key passive solutions focussed on the geometry, but also took inspiration from nature to cool air. In-depth conversations were had to develop pragmatic proposals in keeping with the architecture and targets for the project.

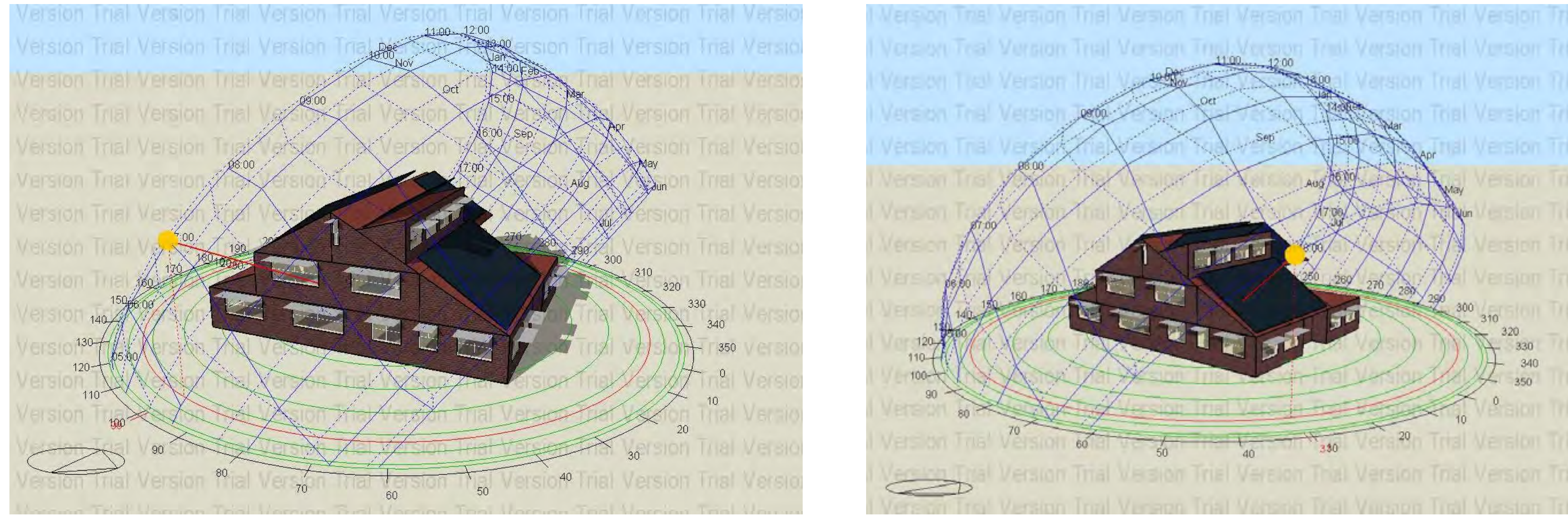
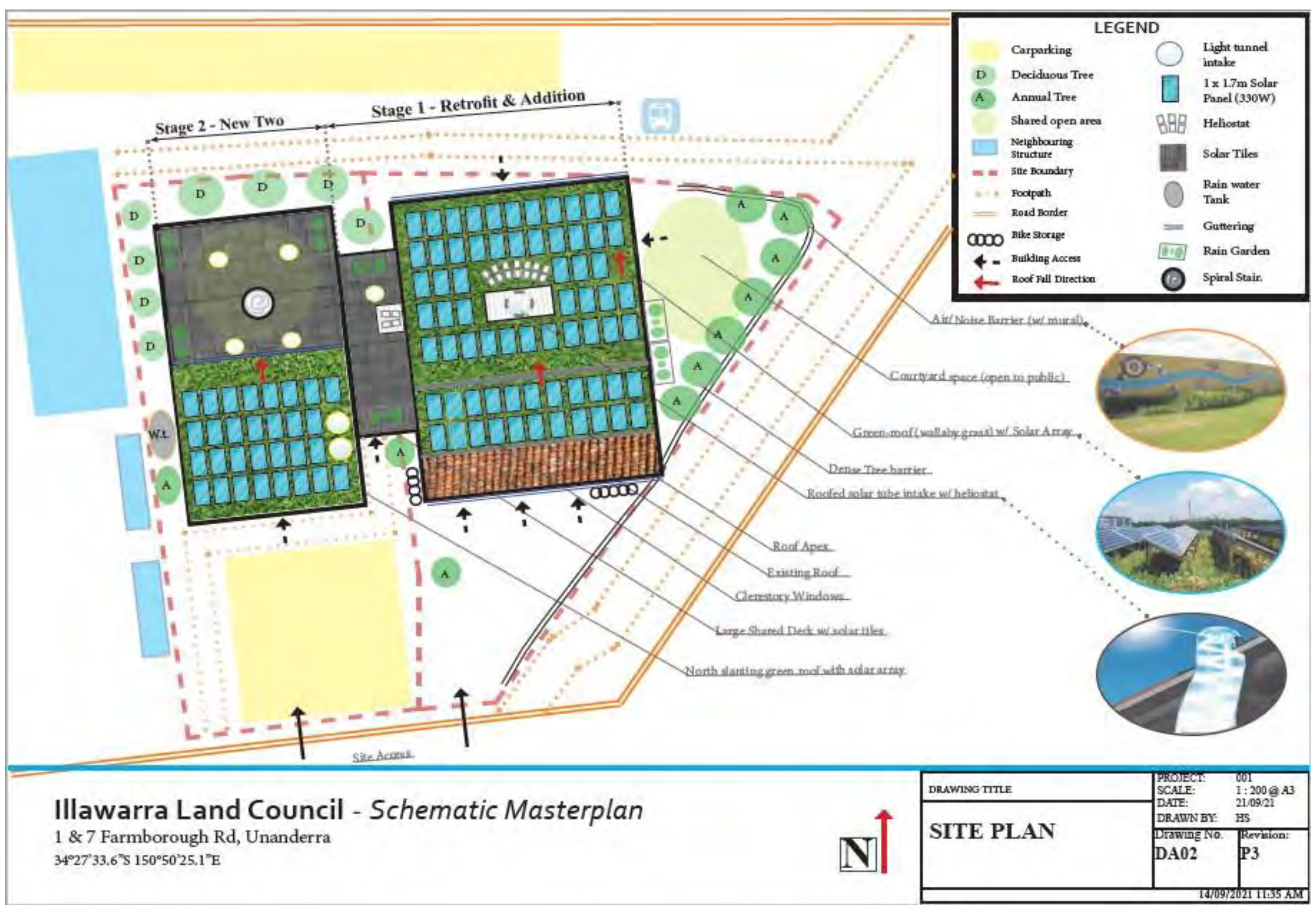


Image: Student 4 Assignment Submission, IDS12



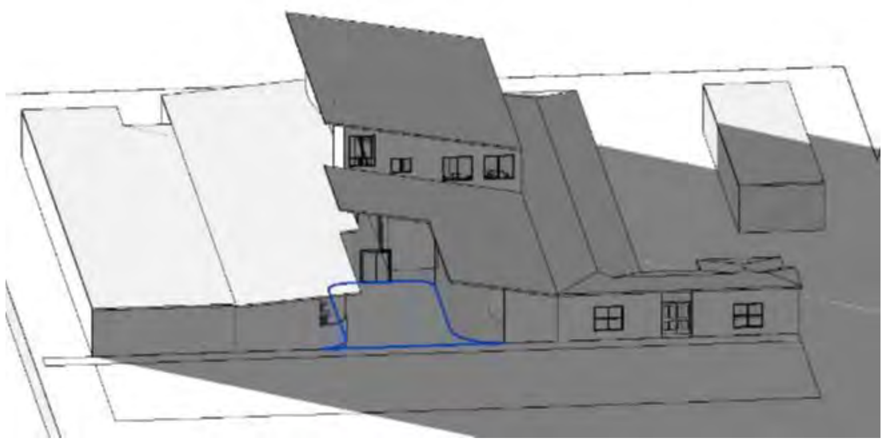


Image: Student 1 Assignment Submission, IDS12

Studio

On-Site Renewables

On-site renewables offer a simple and incredibly effective way to offset electricity consumption within the built form. All buildings providing amenity will consume energy. Once the building's energy consumption has been reduced as far as possible, the next step is to offset it through renewables.

The return on investment is typically high with relatively short payback periods, making it an attractive option.

All new developments should aim to maximise PV, as it provides excellent payback, works towards net Zero and is the single best technology we have.

Most students found that PV had the largest jump in performance when aiming to improve their building performance.

PV systems were considered beyond just the building and sought opportunities beyond the roof.

Students often found that with adequate PV, a REF of >1.0 could be demonstrated through modelling.

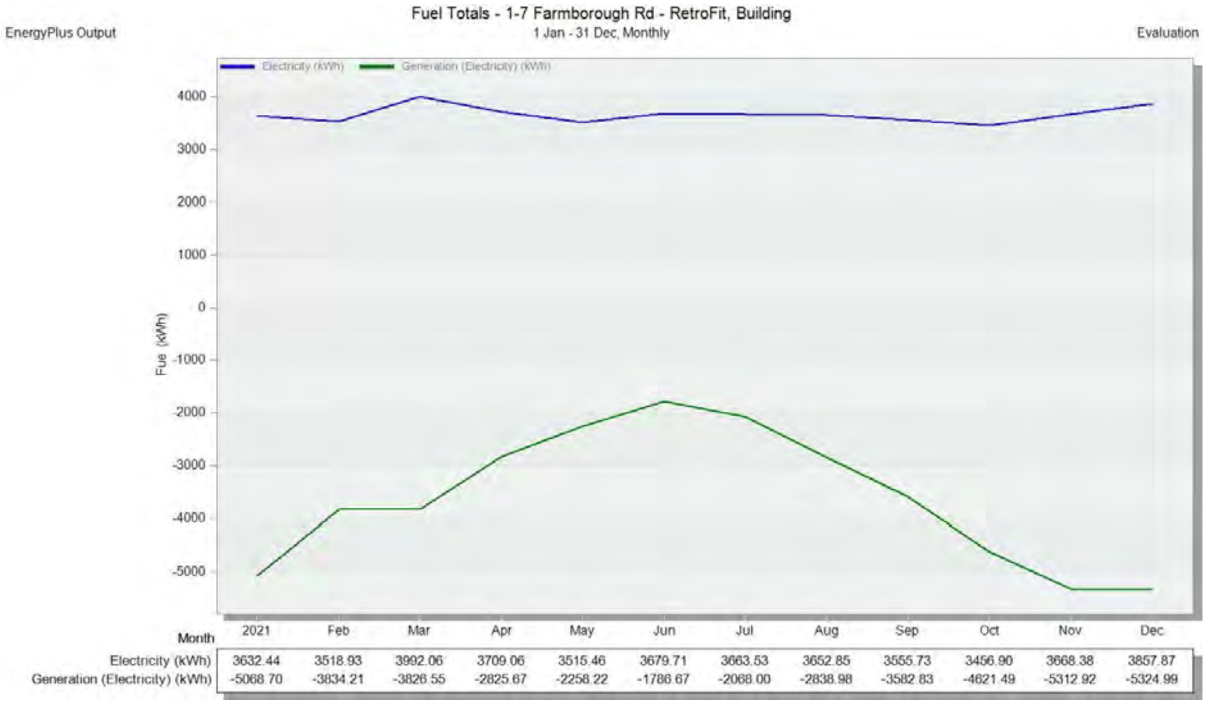


Image: Student 4 Assignment Submission, IDS12
Top: Model showing the PV
Bottom: Graph showing PV production across a typical day

Operational

Operational efficiencies are key to driving sustainability and moving towards net-zero. There was a strong focus from students on this area – initiatives associated with operational efficiency provide good opportunities to analyse carbon benefit, compared to passive examples where occupant behaviour may impact effectiveness.

At a high level, the operational measures fell into the following high level categories:

1. High efficiency systems
2. Operable Blinds
3. Energy management systems

High efficiency:

Typically examples of this include enhanced efficiency of systems compared to business as usual. Business as usual defined by either code (NCC) or standards (AS, MEPS, etc.)

This can also include the application of systems that a non-typical for the proposed application, e.g. the use of centralised heating and cooling for an aged care facility is not standard as it would have a higher capital and maintenance costs which dependent on project specific parameters (climate, location, building design) may not have a good return on investment.

Similarly, items such as high volume, low speed (HVLS) fans which provide cooling comfort to offset air conditioning use were discussed but not analysed – this may require changes to the project brief to enable inclusion.

Operable Blinds:

More Buildings these days are exploring climate-responsive blinds on the outside of buildings. These can be programmed to drop down and block the sun on a schedule or based on an absolute value of solar gains on the façade.

This technology is a simple and effective way to significantly reduce solar gains.

Energy Management Systems

There were discussions in the studio which identified potential savings by managing the use of energy in the facility. These proved harder to assess as they required detailed modelling of both system and occupant behaviour. These are included as they do show good opportunity for carbon savings.

Relaxed cooling and heating setpoints, and occupancy/daylight control of lighting are examples of systems that can be used to manage energy use. Human operation and education is also a critical step to reducing energy. Having users who know how the systems work and can manage their uses around the building's systems is a key step to reducing the building's energy use.

Operational

Relaxed Setpoints

Traditional office design temperature ranges have not changed since comfort models were designed in the 1960's. Design elements, including temperature, humidity, airspeed, clothing and the like are based on a 40-year-old male weighing 70kg in a three-piece suit. Accordingly, the current design of 22.5 ± 1.5°C is an archaic, outdated and sexist temperature range. It also leads to additional wasted energy use consumption.

Adjusting the space to maintain temperature for both males and females equally would result in a step-change in the philosophy of design as well as be an inclusive, modern and responsible change. This could occur in multiple ways to provide greater comfort to all.

- Set a wider temperature range, allowing the space to float between 20.5 - 25°C. Even this slightly warmer temperature could reduce cooling loads by 10%
- Allow different heat zones across the floorplate. Spaces could vary by up to 5°C from the North to South, allowing people to find their sweet spot based on their preference and individual physiology.

The additional comfort, leadership, energy savings and holistic inclusion through this measure would demonstrate a great position in changing the way society sets office temperature ranges.

Operational

Two-Tone Lighting

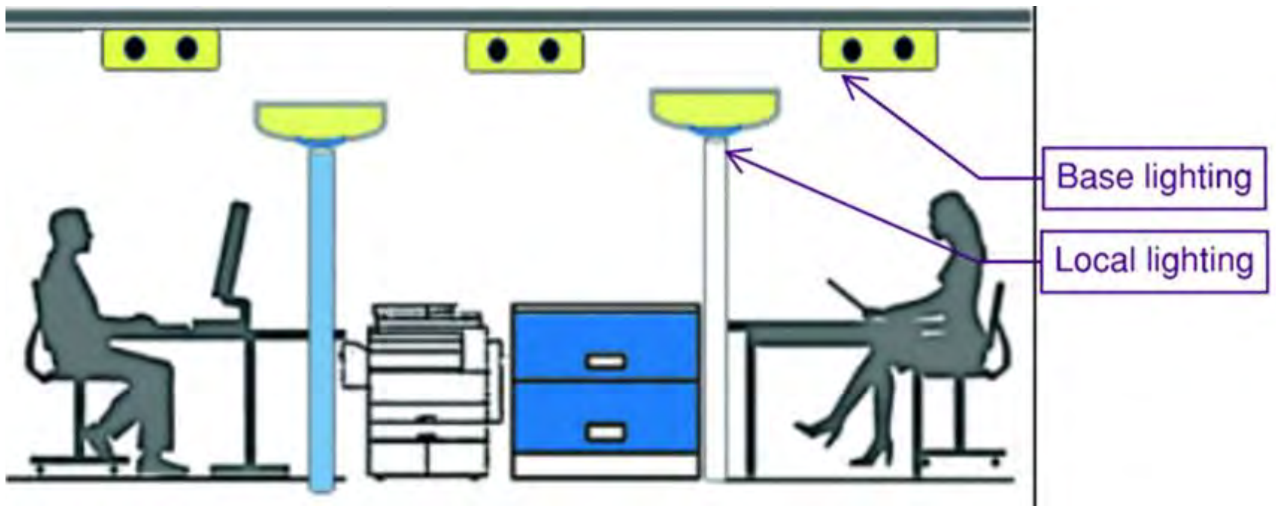
Within the space, lighting is typically one of the largest energy-consuming elements along with small power. Students found this could be up to 40% of the total. A standard lighting design follows AS1680.1, which for an office environment requires 320 Lux to be maintained across the working plane. This is achieved by lighting the entire floorplate to a continuous 320 lux. Such a system consumes approximately 4.5-5.0 W/m2 with even the best LED light fittings available.

The code as a baseline for simple tasks however only requires 160 lux, which requires far lower lighting levels. This level would not be acceptable for working tasks for a long period of time, but is acceptable for most daily tasks.

As a design alternate, significant energy can be saved by implementing a two-tone lighting system. This can be done in a couple of different ways:

Having the ceiling grid designed to achieve 320 lux on all workstations only, with walkways and other spaces lit to only 160 lux.

Having the ceiling grid only designed to 160 lux, and installing specialist lighting within the desks that can light the space to 320 lux. This has the added benefit that individual desks are turned off when no one is at the desk.



On-Site Renewables

Once loads have been minimised, efficiency has been driven as far as possible and unnecessary loads removed, the last opportunity to drive towards net zero is through renewable power.

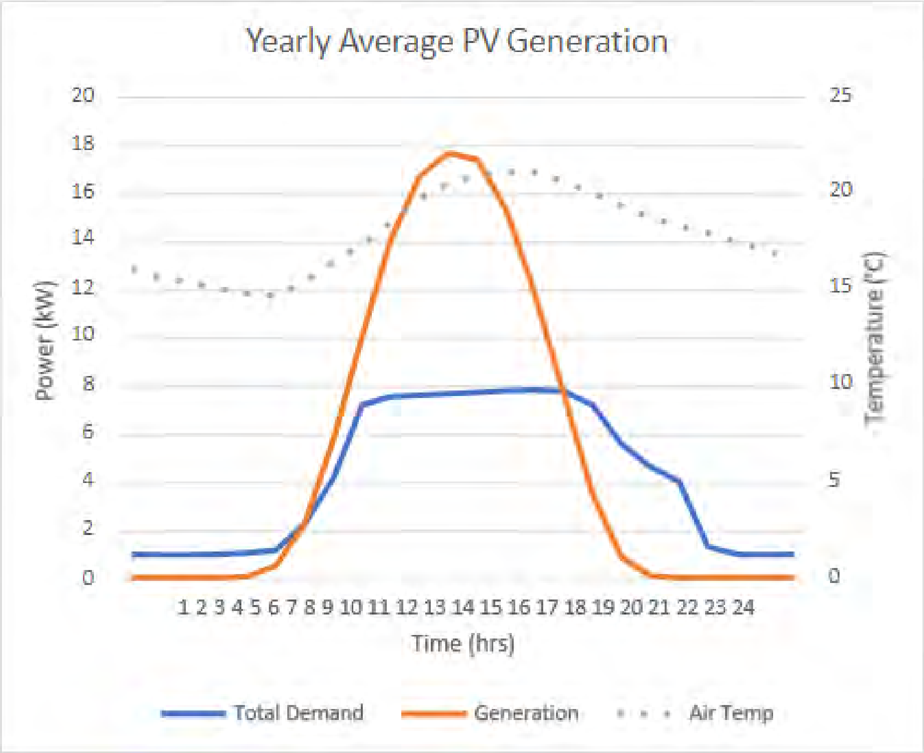
On-site renewables a simple and incredibly effective way to offset electricity consumption within the built form. All buildings providing amenity will consume energy. Once the building's energy consumption has been reduced as far as possible, the next step is to offset it through renewables.

Return on investment is typically high with relatively short payback periods, making it an attractive option.

PV systems design should be integrated into a larger site-wide energy strategy which should consider storage to maximise on-site usage of generated power.

Students' assignments have found that the roof area should be sufficient at Unanderra to drive the project to a net-zero position, including achieving a REF of >1.0

IDS12 Assignment 3: Student 5



IDS12 Assignment 3: Student 8 showing annual generation exceeds demand.

Embodied Carbon

Modular Systems

Modular construction can generally be described as any form of construction where some form of prefabricated component or module is brought to site pre-assembled and erected into the final structural form.

Modular wall design may allow reduced cost, increased flexibility and improved embodied carbon in the space. The key to adjustability is designing wall systems that can be relocated, assembled and disassembled through a kit of parts relatively simply. Partnering with companies that have modular assemblies in place limit the flexibility in design, but can save significant cost, time, material and deliver real sustainability.

Components of the building (such as wet areas) or whole upgrades can be undertaken using prefabricated parts, which can have great end of life properties and a simple yet effective kit of parts.

Studio

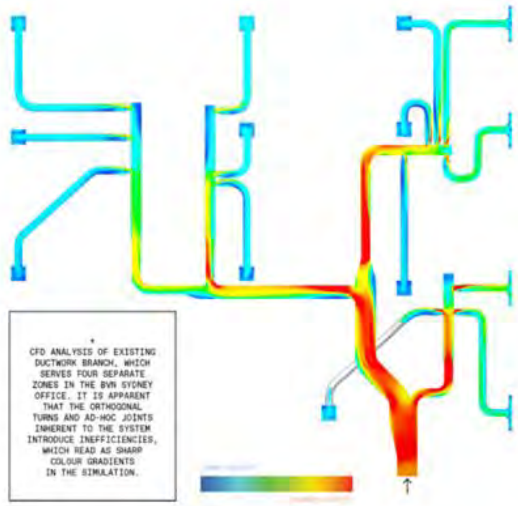
Embodied Carbon

3-D Printed Ductwork

Sydney designed, novel and efficient, the world's first robotically 3D-printed air-diffusion system will improve the operational efficiency and reduce the embodied carbon of the fitout. Air doesn't move at right angles, yet ductwork and air distribution systems are designed this way.

The architectural practice BVN in collaboration with the UTS School of Architecture have designed a 3D printed solution, called [Systems Reef 2 (SR2)]. SR2 reinvents air distribution: replacing steel with recycled plastic, square corners with aerodynamic curves, and large vents with fine pores.

It offers a 90 per cent reduction in embodied carbon when compared to existing systems. Made from recycled plastic waste, it can be fully recycled at the end of its life, exemplifying circular economy principles.



3D Printed Ductwork in BVN's Offices: https://www.hvacrnews.com.au/news/is-this-the-hvac-system-of-the-future/

Embodied Carbon

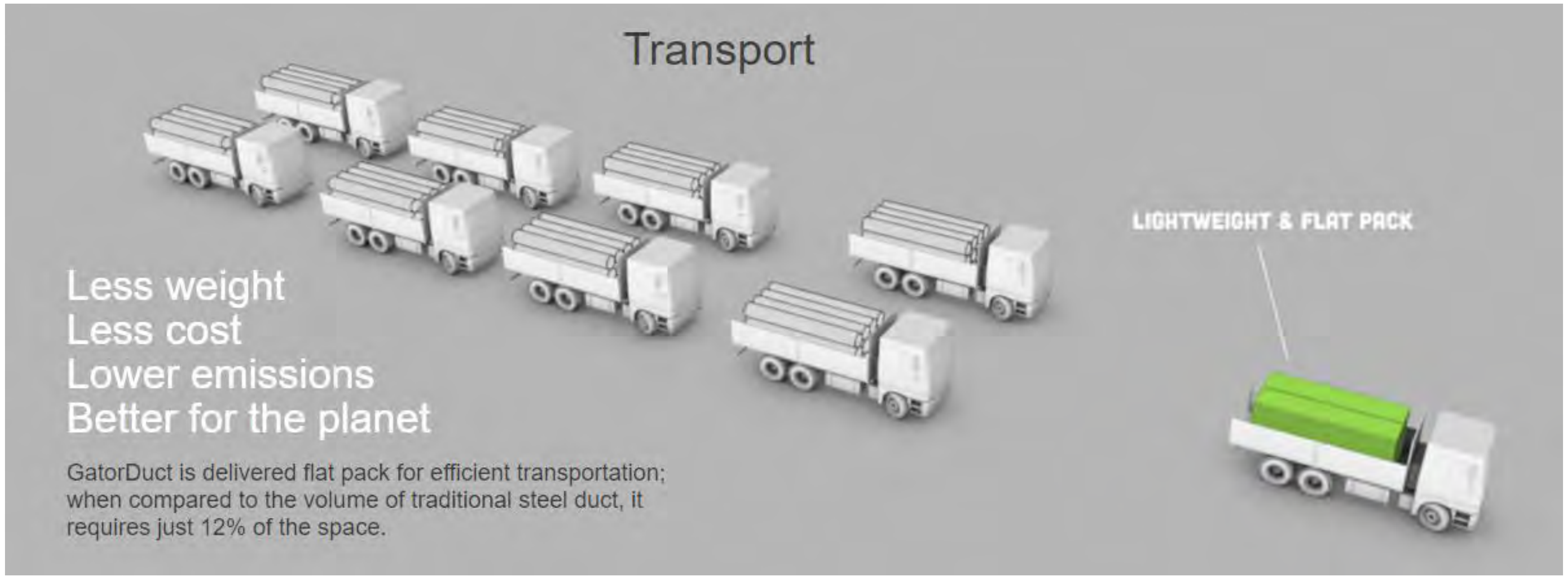
Cardboard Ductwork

The embodied carbon in ductwork could be reduced significantly by replacing it with natural materials such as cardboard. GatorDuct, a maker of engineered cardboard, has developed a low-weight, low-carbon ductwork solution that meets the flexibility and design needs of commercial offices. The system is designed to be fire-retardant, moisture-resistant, water-repellent and completely functional.

Cardboard is 80% lighter and guaranteed to last a lifetime. Cutting and assembly on site is very simple, as can be achieved with just a regular jigsaw.

Shipping and manufacture costs and carbon are significantly reduced, as the low-carbon product can be shipped as a flatpack. This reduces the space required and the number of trucks by up to 88%. Further, branding is simple as any brand, word or symbol can be printed on the duct.

An aboriginal artwork could run through the entire space, painted on the ductwork.



Cardboard ductwork is light, recyclable, low carbon and available: https://www.gatorduct.com/

End of life

Planning the end of life and deconstruction of a building starts in the design phase. The best technique is to ensure the structural life of the building is as long as possible, so the building can have many lives in it's existing form.

The average Sydney office fitout diverts 21% of waste from landfill. 400,000m^2 of commercial office space is refitted each year in Sydney CBD alone, which drives approx. 55,000 tonnes of waste to landfill. Reducing strip-out waste can be achieved by creating clever policies to avoid churn and finding locations for the equipment in the space. This will have multiple benefits:

- Save and make money – monetise unwanted resources and avoid expensive landfill costs
- Reduce landfill – help eliminate the 55,000 tonnes of strip-out waste sent to Sydney landfills each year
- Create a closed-loop economy – support charities by donating materials or help businesses make new products from your waste

Strip out waste guidelines set parameters for fitout tenants to reduce their impacts. More valuably, the Better Buildings Partnership provide a resources workbook, which includes inventory Matrices, reuse directories, calculators to assist with hitting targets and wider project advice.

Creating clever end of life solutions and seeking to find homes for equipment is incredibly important.
https://www.betterbuildingspartnership.com.au/resource/stripout-waste-guidelines-procurement-systems-and-reporting/

Improvement on Business as usual

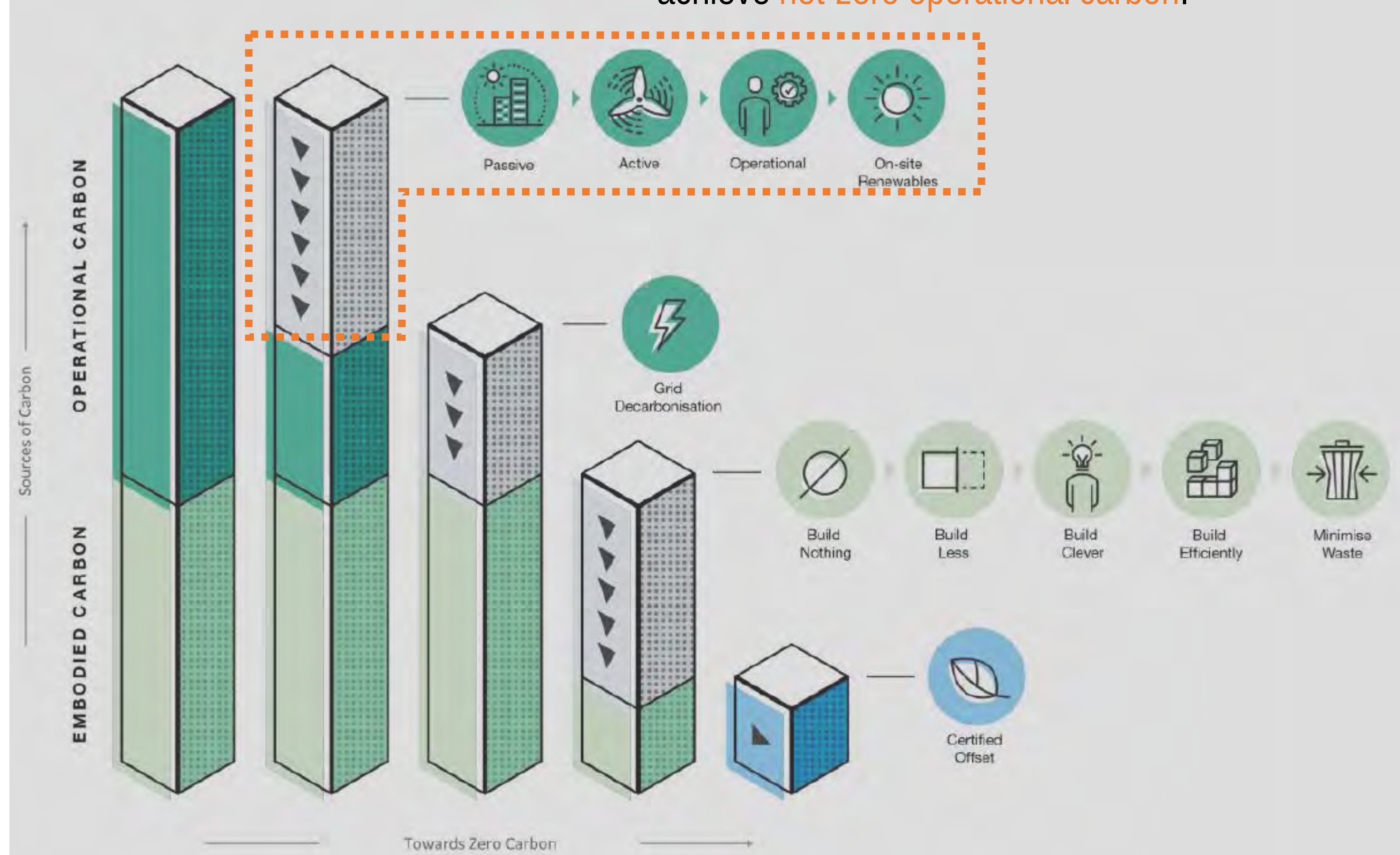
The variability in design of the size and usage of community facilities means there is no single, definitive benchmark available for end of use energy. Functional spaces, building services, size, location, climate, typology are all significant influences on energy and there are large variations of these parameters in comparisons to similar buildings.

The students through their work have developed assessments of potential savings within their proposed scope of study. The combined savings associated with these end use energy components, combined with renewable energy potential would result in a significant reduction in the building operational energy compared to business as usual design.

Passive design features (daylighting, natural ventilation, envelope improvements, etc.) have been found to decrease building services loads in the temperate climate by up to 25%.

Introducing PV onto a site such as this has the capability to achieve a net-zero outcome. This however will still draw power from the grid, but give back an equivalent amount over the 12-month period. Dependent on investment, the savings may be even greater. Minimal analysis was completed on economic effectiveness of the proposed measures – this may impact the adoption of specific initiatives which have lower return on investment.

Many of the proposed initiatives have sympathetic relationships that would enhance their performance – for example, increased envelope performance may reduce fabric loads enough to remove cooling and provide only passive ventilation. Detailed studies into this would unlock even greater savings. Combined with onsite renewable the development could achieve net-zero operational carbon.



Adapted from: Arup.com - net-zero carbon buildings: three steps to take now (2020)

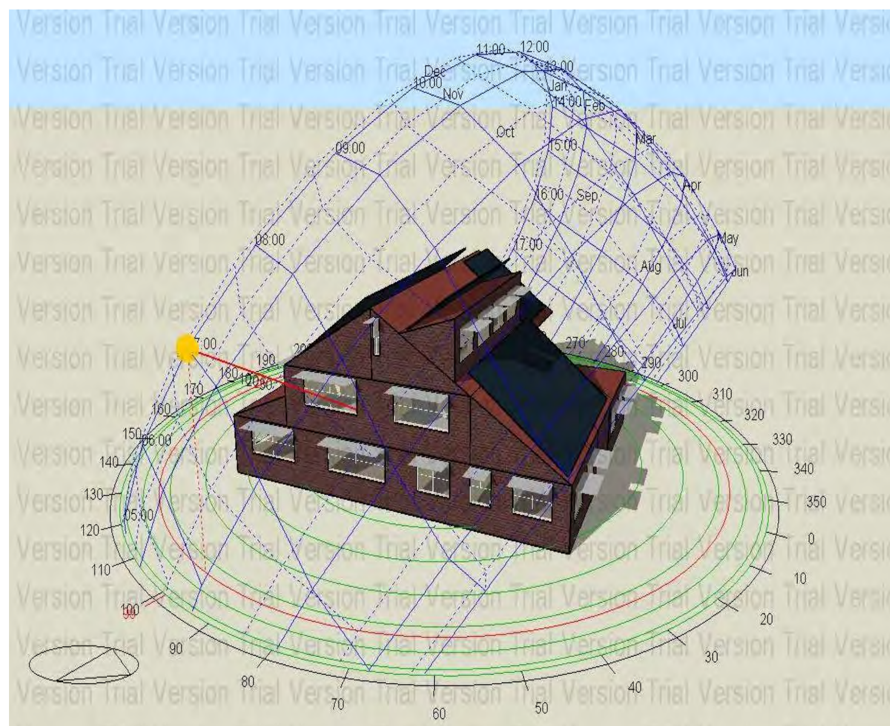
Conclusions

This studio concluded that there are many opportunities to reduce the Unanderra LALC building's carbon during construction, end of life and operation. The focus of this vetting report has typically been on operational carbon and drawn primarily from the students work. It is not exhaustive, and we note that there are other net-zero pathways available for community facilities such as this.

Building design should look to minimise energy use first through passive design minimising the building requirements. This may include adjustment to the user amenity, e.g. nominated thermal comfort requirements. Where energy use is still required, energy recovery and efficiency should be prioritised with management of the energy use playing a key role in optimising the environment. Renewable energy can then cover the remainder, looking onsite first and potentially integrating energy storage and where a shortfall exists, there may be potential to source power from off-site.

As a facility which focusses on communal spaces, consideration should been given to features which can also have other more intangible benefits such as natural daylight providing both carbon reduction and a positive contribution to wellness of the facilities' users.
Reconciliation and Aboriginal Heritage was deemed to be of high importance for the site.

No overarching pathway for net-zero has been presented in the students work, through the individual reports do show a high level of savings is available. Renewable energy will play a key part in finalising the net-zero goal - it has been found that a REF of >1.0 is achievable through considered design and on-site renewables.



Images: Student 4 Assignment, IDS12

Images: Group 2 Assignment, IDS12