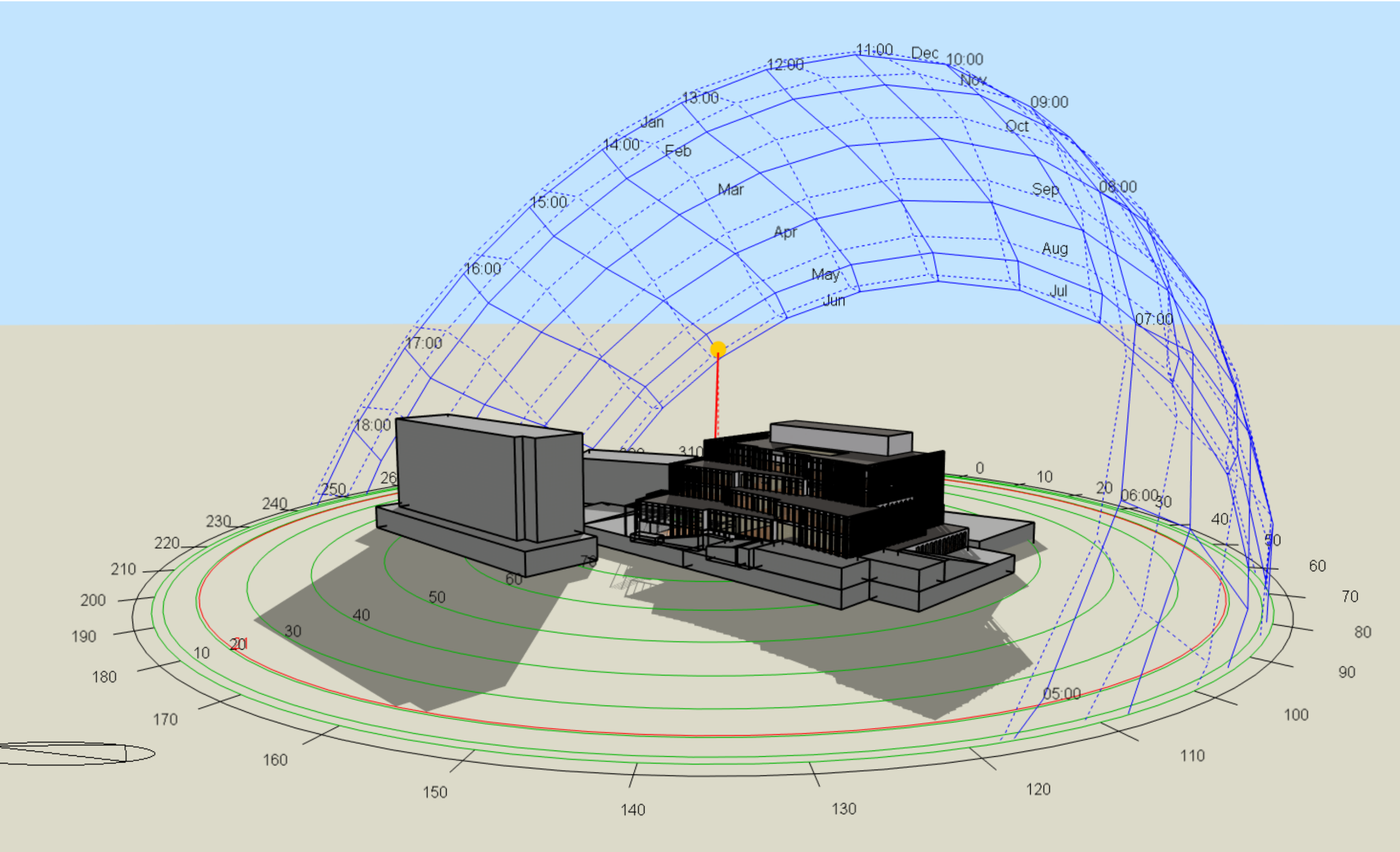

20 Avon Rd, Pymble NSW

Net Zero Emission Assessment Report

25 February 2025

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Document Control

Revision	Date	Author
1.0	25 February 2025	B.Shojaei

CONTENTS

1 Executive Summary

Integrated Group Services (IGS) has been engaged to undertake a Net Zero emission assessment report for the proposed development at 20 Avon Rd, Pymble NSW. This energy modelling and Greenhouse Gas Emission assessment has been conducted in accordance with Green Star Buildings V1 Submission Guidelines – Energy Use, Reference Building Pathway in alignment with Section 35C of the EP&A Regulation - Net zero statement for non-residential development under Sustainable Buildings SEPP.

This following reference document was reviewed:

- The Environmental Planning and Assessment Regulation 2021 (EP&A Regulation) part 8: Ecologically Sustainable Development (ESD), Application number: SSD-79146716, Date of issue, 16/01/2025.

Based on the intent of the net zero statement, we have adapted the Green Star Buildings v1 – Credit Energy Use: Reference Building Pathway in order to target the GHG emission of these areas. This credit defines the reference building as a building modelled to Section J requirements of the National Construction Code 2022 or later.

The Reference building model input for the project was developed using DTS specifications from NCC Section-J 2022 for façade (J4) and services (J5- J9). The Proposed building design is also modelled using the above methodology.

Table 1 provides a summary of the predicted annual energy consumption and GHG emissions from the Reference and Proposed building models. The predicted annual energy consumption for the Proposed building design model is 31.51% lower than that of the Reference building design model.

Table 1. Predicted energy consumption and GHG emissions, Green Star Buildings - Reference Building Pathway.

End Uses	**Reference Building**	**Proposed Building**
	Electricity (kWh)	**Electricity (kWh)**
Heating	58,536	47,885
Cooling	281,707	200,126
Air Conditioning Fans	91,966	94,832
Hydraulic Pumps	11,629	11,629
Interior Lighting	143,625	120,806
Exhaust Fans	58,827	58,827
Lifts	13,591	13,591
DHW	6,097	6,097
Miscellaneous loads	19,979	16,614
110kW Solar PV Elec. Generation (without Battery)	-	(-) 100,598
Total	**685,957**	**469,809**
GHG Emissions Factor ($kgCO_2e/GJ$)	236.0	236.0
Total GHG Emissions($kgCO_2e$)	**582,789**	**399,150**
Reduction (%)	**31.51%**	

If Net Zero emission is to be targeted for the assessed areas, the performance and design documentation for the architectural and building services such as Glazing, Insulation, Internal Lighting, HVAC, and Hot Water shall be consistent with the minimum requirements and assumptions used in this report.

To fully achieve Net Zero GHG Emissions (Carbon Neutrality) for the operational energy consumption of the commercial building, the development may offset an annual electricity consumption of approximately 470 MWh per annum. This may be achieved via purchasing Green Power or other means.

2 Methodology

For the Proposed building, a whole building energy simulation analysis has been carried out to demonstrate that the Proposed building design achieves a significant reduction in predicted energy consumption, and a consequent 30% reduction in GHG emissions when compared to a Section-J compliant DTS Reference building.

The proposed development at 20 Avon Rd, Pymble NSW, comprises of a basement level, a Lower Ground Floor, a Ground Floor and 3 storeys above.

For the whole project, the minimum required deemed- to-satisfy (DTS) provisions for Section-J, has been established as per Volume One of NCC 2022.

The Green Star Energy Simulation guide and Volume 1 of NCC 2022 are used to specify minimum performance parameters for façade and services.

While the Proposed building model geometry is the same as the Reference building model, other parameters and design requirements are described in the following sections of the report.

This Net Zero Statement (as defined in Section 35C of the EP&A Regulation) includes:

- Evidence demonstrating how the development will either be fossil fuel-free from the commencement of occupation or will transition to being fossil fuel-free by 1 January 2035.
- Details of any renewable energy generation and storage infrastructure implemented, as well as any passive and technical design features that minimize energy consumption.
- Estimates of the annual energy consumption for the building and the amount of emissions related to energy use in the building.

3 Building Description

3.1 NCC Climate Zone & Building Classification

The climate zone is defined by the BCA as “an area for specific locations, having energy efficiency provisions based upon a range of similar climatic characteristics”.

The proposed development will be located in Pymble NSW which is within the NCC climate zone 5 (warm temperate). The climate zone map of the development is depicted in Figure 1.

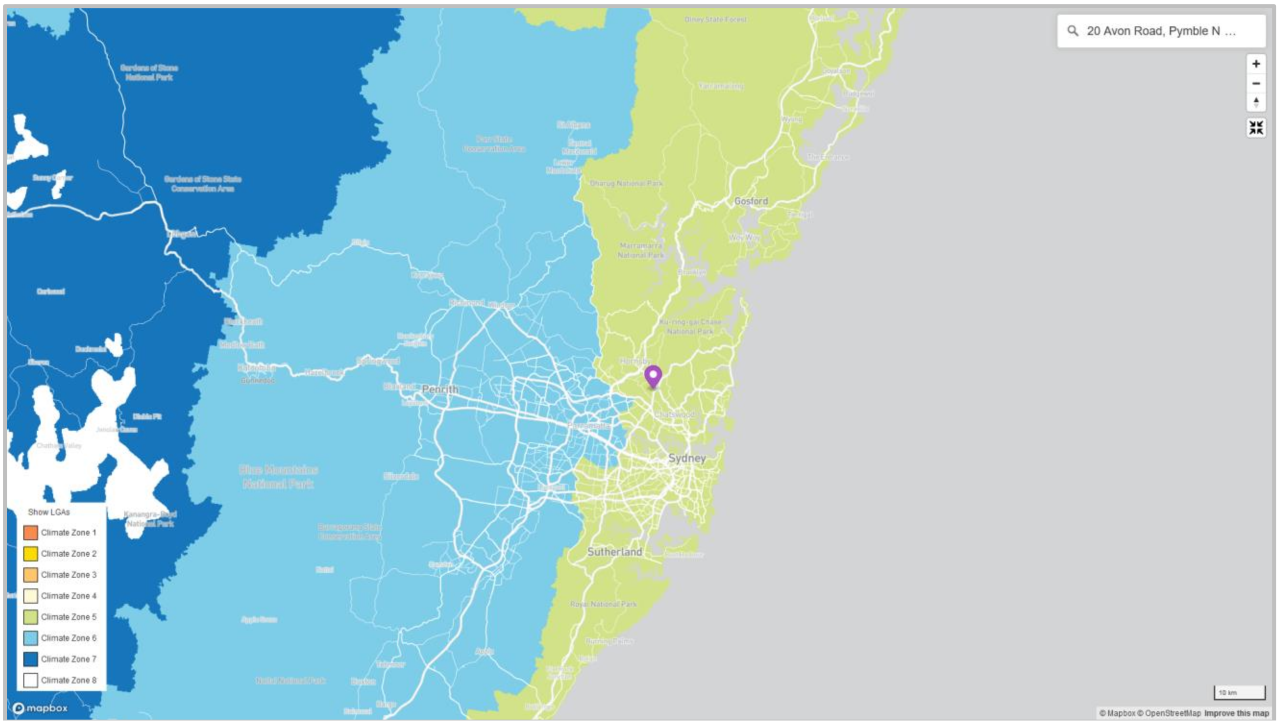


Figure 1. NCC Climate Zone Map.

4 Description of Proposed and Reference Building Models

4.1 Thermal Model Geometry

The proposed development at 20 Avon Rd, Pymble NSW comprises:

- Auditorium, Workshop, Loading dock, Storages and Plant Rooms and in the Basement.
- Kitchens, Canteen, lounge, Classrooms, Workshops and other common areas in the Lower Ground Floor.
- Classrooms, Workshops, Offices, Meeting Rooms, lounge, and other common areas in the Ground Floor and Level 1 to 3.

The building was modelled as per architectural plans and elevations. Figure 2 and Figure 3 provide a representation of various elevations and floors as constructed in the energy simulation model.

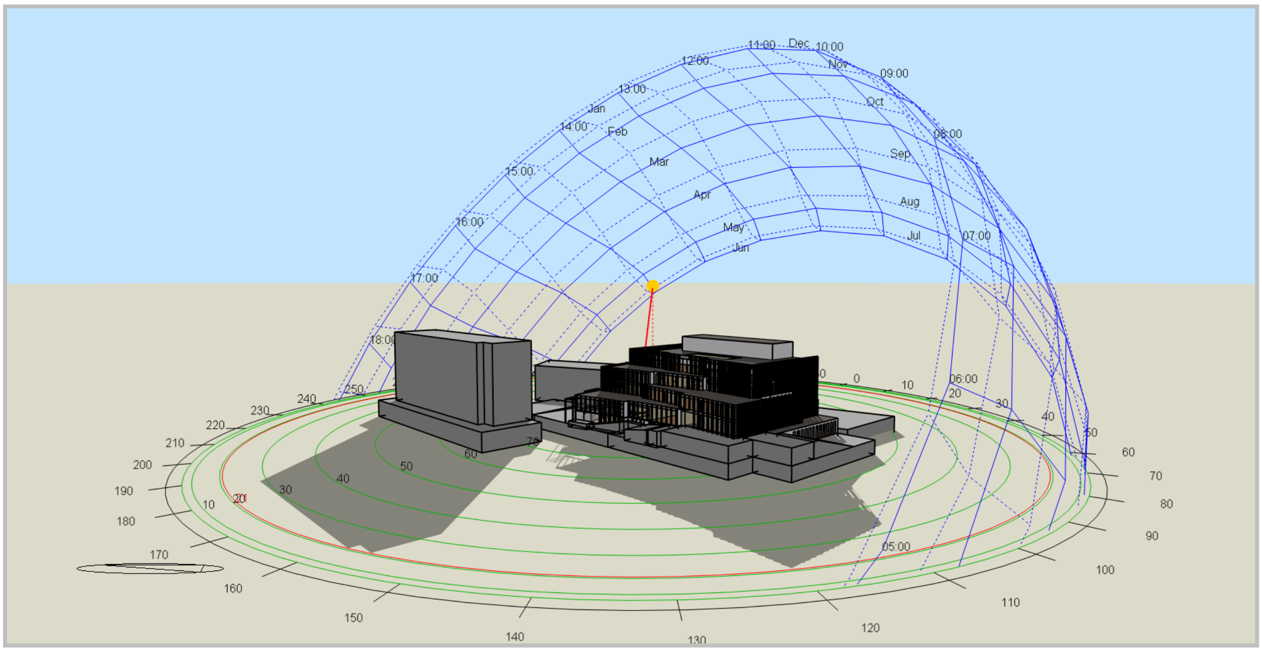


Figure 2. Simulation Model Geometry – Overall View.

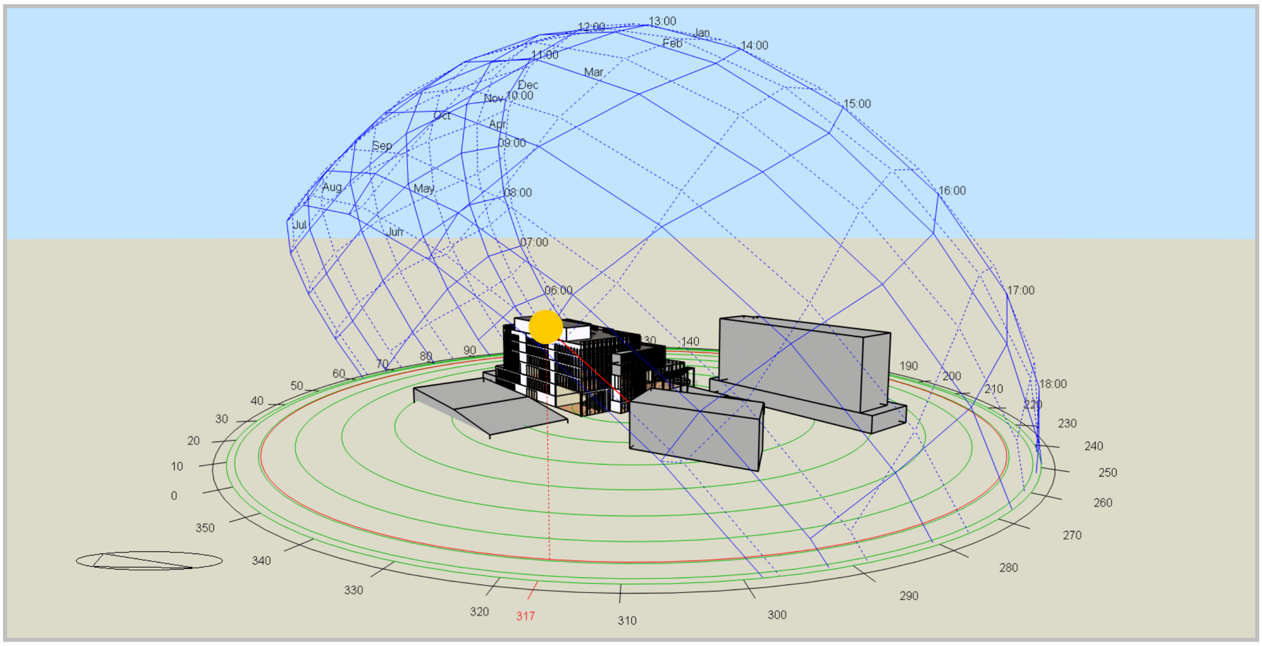


Figure 3. Simulation Model Geometry – East View.

4.2 Reference Drawings

This energy model and consumption estimate, and all inputs and assumptions document herein, are based on the documentation listed below:

- Architectural drawings by 3xn Architects summarized in Table 2:

Table 2. Architectural drawings.

Drawing Title	Drawing No.	Date of Issue
General Project Overview AXO	AR-SIP-A00-1001	15.11.2024
Site Plan - Proposed	AR-SIP-A01-1001	15.11.2024
GA Plans – Basement 01 to Roof Level	AR-SIP-A02-10B1, LG & AR-SIP-A02-1000~ 1005	15.11.2024
Elevations	AR-SIP-A06-1001~1004	15.11.2024
Sections	AR-SIP-A07-1001~1004	15.11.2024
FECA+UCA Area Plans	AR-SIP-A19-1000	15.11.2024
Schedule of Accommodation	AR-SIP-A19-3000	15.11.2024

- Schematic Design Report by ARUP, Reference: SIP-BS-RPT-001, Issue: 25 November 2024.
- 3D IFC model No. 550053 by 3xn architects on date 18.11.2024.
- Energy Use calculation guide Guidance on calculation methods for the Energy Use credit - Version 1, October 2022.
- Green Star Buildings Submission Guidelines – Version 1: Revision B, December 2021.
- NCC 2022 Volume 1. - Section J.
- Riverview Observatory NSW Typical Meteorological Year (TMY) recorded Weather Data.

4.3 Analysis Software

Computer modelling was performed using the Design Builder software to predict the annual mechanical energy consumption requirements for the building. This program uses a dynamic simulation to assess the building envelope response as well as space and surface temperatures, internal loads and energy consumption.

To ensure appropriate results are derived from the software package, ABCB requires that the software conform to appropriate BESTEST validation test or be certified in accordance with ANSI/ASHRAE Standard 140-2001: “Standard Method of Test for Evaluation of Building Energy Analysis Computer Programs”. Design Builder satisfies this requirement.

The Design Builder program models the heat exchange between the air-conditioned space and the external environment to the space, hot or cold bodies in the space including people, lighting, and machines, and the air-conditioning system. The external environment includes the external ambient conditions and adjacent spaces.

The heat exchange analysis includes convection to and from surfaces, radiation exchange to and from the external environment, radiation exchange between the space internal surfaces, conduction through surfaces, and changes in humidity.

The software addressed all the main aspects of thermal modelling such as:

- Energy flow through the building’s envelope, including at adiabatic surfaces and also including thermal storage effects. Accurately modelling the performance of the air-conditioning and ventilation systems, including plant and equipment using their energy input ratios, coefficients of performance, or efficiency at full and part load. Control strategies, sequencing of plant and equipment, controlled settings and types of controls. Relative humidity range; and Use of different energy types.

The energy consumption outputs from the program were used as inputs to this assessment.

This Energy Simulation analysis has been carried out using the Energy Plus energy simulation developed by the USDOE. Energy Plus development is continually tested using industry standard methods as major builds are completed. Three major types of tests are currently conducted:

a. Analytical tests:
   - HVAC tests, based on ASHRAE Research Project 865
   - Building fabric tests, based on ASHRAE Research Project 1052

b. Comparative tests:
   - ANSI/ASHRAE Standard 140-2011
   - International Energy Agency Solar Heating and Cooling Programme (IEA SHC) BESTEST (Building Energy Simulation Test) methods not yet in Standard 140
   - Energy Plus HVAC Component Comparative tests Energy Plus Global Heat Balance tests

c. Release and executable tests

The BESTEST suites compare the results of multiple simulation programs for a series of load-related attributes.

Therefore, the Design Builder simulation suite complies with the ABCB software protocol. The Design Builder graphic user interface (GUI) has been used to develop the complex building geometry with external shading and to access the power of Energy Plus.

Table 3. Energy simulation analysis software description.

Software name and version	Design Builder v7.0.0.082
Software developer	Design Builder Software Ltd / USDOE
Software validation standard	BESTEST

4.4 Weather Data

Historical hourly local weather data, in the form of twelve months' data, was used to represent the building external ambient data at the building location and to accurately model the dynamic nature of building thermal response. The weather data contains hourly records of radiation, temperature, humidity, sunshine duration and wind speed and direction for a typical meteorological year. Based on the location of the development, the weather data from the closest weather station was used for the simulation of all models (Riverview Observatory NSW, approx. 9.5 km from the site) The weather station distance from site is illustrated in Figure 4 and Table 4 outlines details of the simulation weather file. The Typical Meteorological Year (TMY) weather file represents a year without unusual extremes in temperature or typical average conditions, suitable for energy simulation modelling.

Table 4. Simulation weather file details.

Weather File Property	Value
Location	Riverview Observatory NSW
Weather File Type	Typical Meteorological Year (TMY)

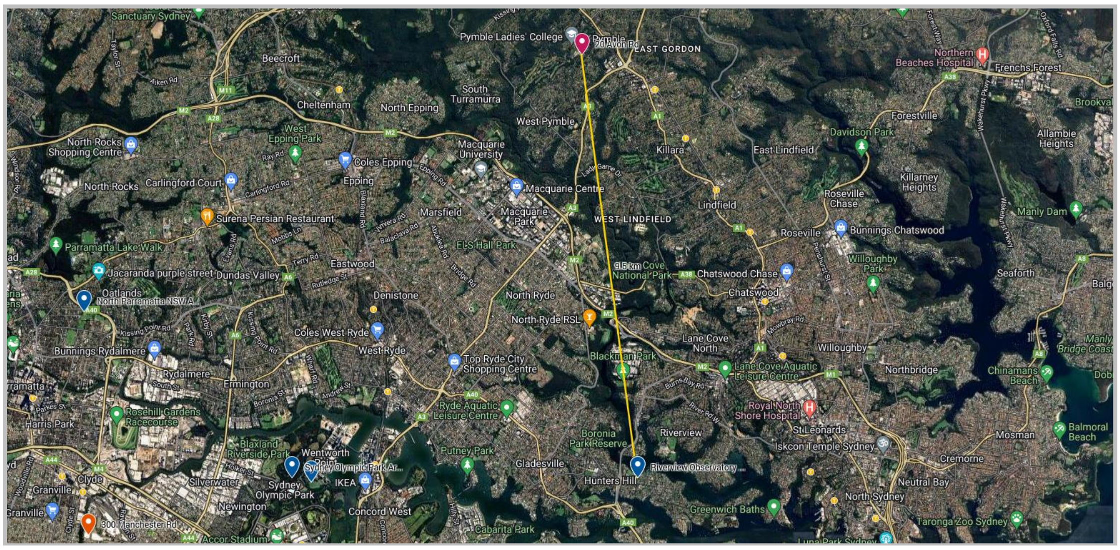


Figure 4. Weather Station distance from site.

4.5 General Modelling Parameters

Table 5 outline the parameters were applied for both the Reference and the Proposed building models developed for this project:

Table 5. General modelling parameters.

Items	Proposed Building	Reference Building
Climate zone	NCC climate zone 5	Same as Proposed Building
Weather data	Riverview Observatory NSW	Same as Proposed Building
Total modelled building gross floor area (GFA)	10,953.7 m^2	Same as Proposed Building
Building Orientation	As per Architectural Drawings	Same as Proposed Building
Heating fuel(s)	Electricity	Same as Proposed Building
Cooling fuel(s)	Electricity	Same as Proposed Building
Infiltration	• 0.7 air changes per hour throughout all zones when there is no mechanically supplied outdoor air; • 0.35 air changes per hour at all other times.	Same as Proposed Building

4.6 Space Summary

Modelling parameters for each of the space types included in the building simulation models are described in the Table 6:

Table 6. Space summary.

SPACE TYPE	**Theatre Areas**
Occupancy Profiles	NCC Class 9b - Theatre profile
Temperature Control Range	21°C to 24°C
Occupant Density m^2/person	1
SPACE TYPE	**School Canteen Areas**
Occupancy Profiles	NCC Class 6 profile - Cafe
Temperature Control Range	21°C to 24°C

Occupant Density m^2/person	1
SPACE TYPE	**College Areas**
Occupancy Profiles	NCC Class 9b school profile
Temperature Control Range	21°C to 24°C
Occupant Density m^2/person	2
SPACE TYPE	**Office Areas**
Occupancy Profiles	NCC Class 5 office profile
Temperature Control Range	21°C to 24°C
Occupant Density m^2/person	10
SPACE TYPE	**Conditioned Common Areas**
Temperature Control Range	21°C to 24°C
SPACE TYPE	**Conditioned Common Areas -Transitory Occupancy**
Temperature Control Range	18°C to 25°C
SPACE TYPE	**Unconditioned Common Areas**
Temperature Control Range	-
Occupant Density m^2/person	-

4.7 Building Fabric

The constructions input to the Reference and Proposed building models are described below. Table 7 address the opaque fabric of the building model.

4.7.1 Opaque Fabric Components

Table 7. Building Fabric – Minimum Thermal Performance.

Section	Item	Proposed Building	Reference Building
J4D4	**External Roof**	As per Reference Building	Total thermal insulation R3.7 as per NCC 2022 J4D4
J4D6	**External Wall**	As per Reference Building	Total thermal insulation R1.5 as per NCC 2022 J4D6 (DTS Façade Calculator)
	Internal walls	As per Reference Building	Total thermal insulation R1.0 as per NCC 2022 J4D6 (DTS Façade Calculator)
J4D7	**Envelope Floor**	As per Reference Building	Total thermal insulation R2.0 as per NCC 2022 J4D7

4.7.2 Transparent Fabric Components for Reference Building

Table 8 outlines the glazing and thermal insulation levels utilised in the Reference Building simulations. The NCC Section-J glazing calculator has been used to specify just compliant window systems for the Reference building model. To ensure glazing consistency, identical glazing performance has been nominated for all aspects (based on the minimum requirements obtained from NCC Section J DTS Façade Calculator).

Table 8. Transparent fabric components for reference building.

Level	Reference Building	
	U-Value	SHGC
Basement1	4.07	0.36
Lower Ground Level	5.8	0.66
Ground Floor	3.65	0.34

Level	Reference Building	
	U-Value	SHGC
Level1	3.33	0.33
Level2	3.82	0.36
Level3	3.76	0.34

4.7.3 Transparent Fabric Components for Proposed Building

Table 9 provides these performance parameters applied by space type, to the Proposed building model.

Table 9. Proposed Glazing Selection.

	All Aspects	
	U-Value	SHGC
Glazing Component	5.0	0.5

Definitions for window glazing systems in relation to the NCC are as below:

- U-value, in W/m^2-K, NFRC winter values, for the whole window (glass + framing)
- SHGC = solar heat gain coefficient, dimensionless

4.8 Internal heat loads and occupancy density

The internal heat loads applied to both the Reference and Proposed models are provided in Table 10 The occupancy, lighting and equipment loads have been uniformly distributed throughout the building.

Table 10. Load Details.

Item	Details
People Load	• Dining Room, Restaurant or café: 80 W sensible heat gain and 80 W latent heat gain. An average adjusted metabolic rate from Table 45 of AIRAH-DA09 A heat emission rate from Table 6.3 of CIBSE Guide A. • Other Applications: 75 W sensible heat gain and 55 W latent heat gain. An average adjusted metabolic rate from Table 45 of AIRAH-DA09. A heat emission rate from Table 6.3 of CIBSE Guide A.
Hourly Profile	Based on NCC Specification Table S35C2c, S35C2d, S35C2f, S35C2h and S35C2j.
Internal heat gains for appliances and equipment	Based on NCC Specification 35 Table S35C2l.

4.9 Infiltration Rates

The infiltration rates have been included in both the “reference” and “proposed” models in compliance with Specification 34 of the NCC.

4.10 Shading

All external shading has been incorporated in the model based on the provided architectural drawings.

4.11 HVAC Services

The HVAC systems for both the Proposed Building and Reference Building models were simulated in Design Builder software package. The following temperature bands were adopted for 98% of the plant operation time.

- 18°CDB to 25°CDB for conditioned spaces with transitory occupancy; and
- 21°CDB to 24°CDB in all other conditioned spaces

The mechanical systems for the Reference Building model were simulated with the input parameters in accordance with the DTS Requirements of NCC Part J6.

The heating and cooling COPs for the proposed building's HVAC system are set at 4.5, based on the Schematic Design Report by ARUP (Reference: SIP-BS-RPT-001, Issue Date: 25 November 2024).

Figure 5 demonstrate the HVAC detail applied to the models. The HVAC systems were simulated based on a selected set of monthly design day temperatures and coincident wet bulb temperatures. The part load performance curves adjust the efficiency of the system based on the capacity, as well as the supply air and environmental conditions.

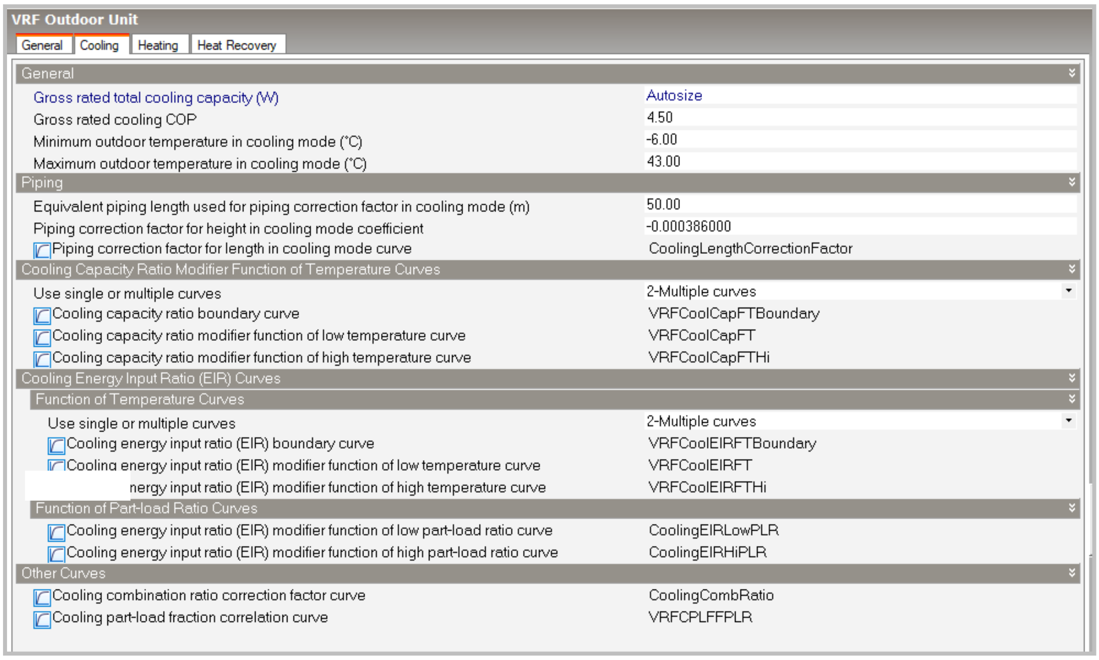


Figure 5. Sample of input data for detailed HVAC modelling – proposed building outdoor unit.

4.12 Internal Lighting System

The Reference building design has been modelled with Illumination power density in accordance with Table J7D3a of NCC 2022. This follows the process methodology detailed in Table 1: Modelling requirements for the Proposed and Reference Project in the Green Star Energy Consumption and Greenhouse Gas Emissions Calculation Guide. However, for the Proposed building design, internal lighting layouts have not been finalised as the project is still pending final development consent. Hence, the Proposed building design has been modelled with industry standard practice lighting systems, with equivalent lighting power densities as listed in the table below. Table 11 provides the Reference and Proposed buildings lighting energy consumption.

Table 11. Internal lighting system - Reference.

	Illumination Power Density (W/m^2)	
	Reference building	**Proposed building**
Auditorium	8.0	6.4
Office	4.5	3.6
Break out space	4.5	3.6
Classroom and workshop	4.5	3.6
Canteen	14.0	11.0
Kitchen	4.0	3.2
Plant	4.0	3.2

	Illumination Power Density (W/m²)	
	Reference building	**Proposed building**
Corridors	5.0	4.0
Kitchen	4.0	3.2
Loading dock	2.0	2.0
Lobby	5.0	4.0
storage	1.5	1.5
Laundry & Services	1.5	1.5
Stairways	2.0	2.0
Toilet	3.0	2.5
External	1.0	1.0

4.13 Domestic Hot Water

For both the Reference and Proposed Building model, the annual DHW demand was calculated based on Green Star potable water calculator and was used to derive the annual energy consumption for this end use. The end of trip facility hot water consumption is estimated based on Green Star potable water calculator.

The general form of the annual energy calculation is as follows (equation 1):

$$Q_{input} = \frac{q_{DHW} c_p \Delta T}{1000\, \eta_{heater}} (1 + f_{standing} + f_{distribution}) \qquad (1)$$

Where Q_{input} is the system total annual energy consumption (kWh), q_{DHW} is the system annual domestic hot water usage (L/annum), cp is the specific heat capacity of water (approximately 4.192 kJ/kg.K), ΔT is the temperature difference between supply and make up water temperatures (K), η_{heater} is the gross thermal efficiency of the water heater (%), $f_{standing}$ is a factor accounting for standing losses in the system, and $f_{distribution}$ is a factor accounting for distribution losses in the system.

Table 12 shows the parameters used in estimation.

Table 12. Parameters used in DHW estimation.

Parameter	Value
Cp	4.192 (kJ/kg K)
ΔT	35°C (60-25)
Standing Factor	0.01 (based on Green Star)
Distribution Factor	0.05 (based on Green Star)

Table 13 shows the domestic hot water energy consumptions required to be included in the model.

Table 13. DHW Energy Consumption.

	Annual consumption	
	Reference Building	**Proposed Building**
Annual DHW Demand (kL/annum)	466	466
Total Energy Use for DHW Heating (kWh/annum)	5,752	5,752
Standing Loss (kWh/annum)	58	58
Distribution Loss (kWh/annum)	287	287
Total annual Consumption (kWh/annum)	6,097	6,097

4.14 Ancillary Mechanical Ventilation Fans

The proposed building design has ancillary mechanical ventilation for the internal areas. The estimated energy calculated by the mechanical ventilation systems are applied to both the proposed and the reference buildings. Table 14 shows the estimated energy consumption of ancillary mechanical ventilation fans.

Table 14. Ancillary mechanical ventilation fans.

	Annual energy consumption (kWh)	
	Reference building	**Proposed building**
Ventilation and exhaust fans	58,827	58,827

4.15 Lifts

The annual energy consumption represented by the lifts were calculated using the equation 4: (adapted from Barney, 2007):

$$E = N \frac{\overline{T}_{trip}}{3600} \dot{Q}_{avg} + \dot{Q}_{standby} T_{standby} D_{standby} \quad (4)$$

Where,

E: annual energy consumption of the lift (kWh/annum).

Table 15 estimates the Lift energy consumption which has been included in the model based on Schematic Design Report by ARUP, Reference: SIP-BS-RPT-001, Issue: 25 November 2024.

Table 15. Lifts energy consumption.

Lift Number	Elevations heigh (m)	Building Lift Energy Calculation
1	20.52	5,577
2	24.48	6,381
3	3.96	1,632
Total Annual Energy Consumption (kWh)	-	**13,591**

4.16 Hydraulic Pumps

Table 16 shows the estimated hydraulic pumps energy consumption which has been included in in both the proposed and the reference buildings. Annual water demands are estimated based on Green Star Potable Water Calculator.

Table 16. Hydraulic Pumps Energy Consumptions.

	Total Flow (kL/Annual)	Max. Pressure (kPa)	Estimated Pump Power (kW)	Annual Energy Consumption (kWh)
Domestic Hot Water Recirculation	466	500	0.3	1,004
Potable Water Pressurisation	1,797	500	1.3	3,871
Non-Potable Water Pressurisation	3,001	500	2.1	6,465
Fire Service	134	500	0.1	289
Total	-	-	-	**11,629**

4.17 Miscellaneous Loads

Table 17 shows the estimated Miscellaneous Loads energy consumptions required to be included in this assessment.

Table 17. Miscellaneous Loads Energy Consumptions.

System	Demand	Annual Miscellaneous Loads Energy Consumption (kWh)	
		Reference Building	Proposed building
BMS, Leak Detection, Fire Alarm, Cable Losses, Security Control Systems	3% of Total Electrical Consumption	19,979	16.614

4.18 NCC Greenhouse Gas Emission Factors

The annual greenhouse gas emissions for the proposed building and the reference building have been calculated using the greenhouse gas emissions factors outlined in Table 18.

Table 18. NCC Greenhouse Gas Emission Factors.

Energy Source	GHG emissions factors (kgCO_2-e/GJ)
Electricity	236

4.19 Onsite Energy Generation

JV3 allows the renewable energy generated on-site or the "free" energy derived from another process (e.g. heat from cogeneration) to be deducted from the annual energy consumption of the proposed building. This means that the "annual energy consumption" is the sum of the energy drawn annually from the electrical grid, the gas network or fuel brought in by road transport and not the total of the energy consumed by the services that use energy.

4.19.1 Solar PV

The Photovoltaic (PV) system may consist of the main components or of equal capacity detailed in Table 22.

Total nominal power: 110 kW

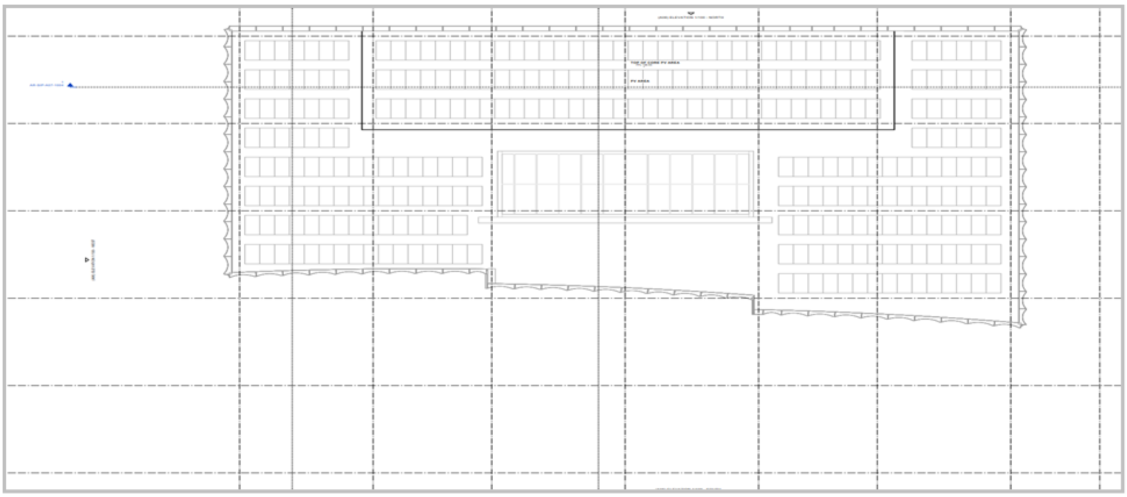
Approx. roof space requirements: 688 m^2

Table 19. Main components of photovoltaic (PV) system.

Components	Brand, Model & Quantity
PV Inverter	Sungrow – Quantity: (1)x 90 kW or equivalent
PV Panels	Trina - TSM-600-DEG20C – capacity: 600W - Quantity: 184 Approx.
Battery storage	the system to be sized during the detailed design stage, based on the final PV capacity as well as the electrical design for lower reliance on electrical network due to maximum demand constraints.
PV mounting frame and system balance	Quantity: depending on the requirements and final design

The minimum onsite Solar PV capacity required for the development is 110kW. The energy generated by the solar PV shall be consumed on site. The exact sizing, configuration and final design will be completed during the design stage.

Roof Plan with approx. Solar PV Space:



4.19.2 Solar PV – Projected Energy Generation for a 110-kW System

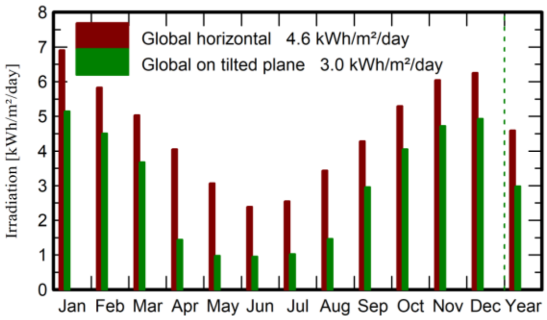
Grid system presizing

Geographical Site		**Situation**	
Sydney/Clontarf		Latitude	-33.82 °S
Australia		Longitude	151.27 °E
		Altitude	11 m

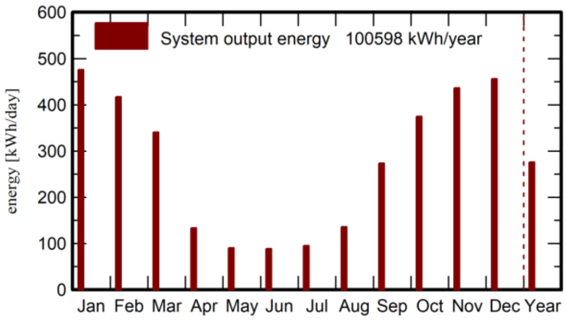
System summary

Nominal power	110 kWp	Total area	688 m²
Module type	Standard	Supports for modules	Facade or tilted roof
Technology	Monocrystalline cells	Ventilation property	Free air circulation

Weather data and incident energy



System output



	Horizontal global kWh/m²/day	Coll. plane kWh/m²/day	System output kWh/day	System output kWh
Jan.	6.91	5.14	475.5	14741
Feb.	5.83	4.51	416.8	11671
Mar.	5.03	3.68	340.3	10548
Apr.	4.05	1.44	133.6	4007
May	3.07	0.98	90.44	2804
June	2.39	0.95	88.19	2646
July	2.55	1.03	94.84	2940
Aug.	3.44	1.47	135.5	4201
Sep.	4.28	2.96	273.6	8207
Oct.	5.30	4.05	374.6	11612
Nov.	6.05	4.72	436.3	13090
Dec.	6.25	4.93	455.8	14131
Year	4.59	2.98	275.6	100598

5 Results

This reduction in GHG emissions has been achieved by higher performance HVAC systems, higher performance lighting Systems and on-site renewable energy generation. The predicted reduction in emissions is achieved without considering improvements to the Reference case for lifts and exhaust fans, and the results may be considered conservative.

Table 20 provides a summary of the energy simulation results for the Reference building design model and the Proposed building design model. These results are developed by using the predicted annual energy consumption numbers from the Energy Plus simulation runs.

The predicted annual greenhouse gas emissions for the Proposed building design model is 31.51% lower than that of the Reference building design model.

This reduction in GHG emissions has been achieved by higher performance HVAC systems, higher performance lighting Systems and on-site renewable energy generation. The predicted reduction in emissions is achieved without considering improvements to the Reference case for lifts and exhaust fans, and the results may be considered conservative.

Table 20. Summary of energy simulation results.

End Uses	**Reference Building Electricity (kWh)**	**Proposed Building Electricity (kWh)**
Heating	58,536	47,885
Cooling	281,707	200,126
Air Conditioning Fans	91,966	94,832
Hydraulic Pumps	11,629	11,629
Interior Lighting	143,625	120,806
Exhaust Fans	58,827	58,827
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110kW Solar PV Elec. Generation (without Battery)	-	(-) 100,598
Total	685,957	469,809
GHG Emissions Factor ($kgCO_2e/GJ$)	236.0	236.0
Total GHG Emissions($kgCO_2e$)	**582,789**	**399,150**
Reduction (%)	**31.51%**	

If Net Zero emission is to be targeted for the assessed areas, the performance and design documentation for the architectural and building services such as Glazing, Insulation, Internal Lighting, HVAC, and Hot Water shall be consistent with the minimum requirements and assumptions used in this report.

To fully achieve Net Zero GHG Emissions (Carbon Neutrality) for the operational energy consumption of the commercial building, the development may offset an annual electricity consumption of approximately 470 MWh per annum. This may be achieved via purchasing Green Power or other means.

6 Disclaimer

This report is prepared using the information described above and inputs from other consultants. Whilst IGS has endeavoured to ensure the information used is accurate, no responsibility or liability to any third party is accepted for any loss or damage arising out of the use of this report by any third party. Any third party wishing to act upon any material contained in this report should first contact IGS for detailed advice which will take into account that party's particular requirements.

Computer performance assessment provides an estimate of building performance. This estimate is based on a necessarily simplified and idealised version of the building that does not and cannot fully represent all the intricacies of the building once built. As a result, simulation results only represent an interpretation of the potential performance of the building. No guarantee or warrantee of building performance in practice can be based on simulation results alone. IGS and its employees and agents shall not be liable for any loss arising because of, any person using or relying on the Report and whether caused by reason or error, negligent act or omission in the report. The draft assessment has been prepared based on the preliminary building services and architectural design with the view to conduct a detailed assessment once the design is further developed.

The performance and design documentation for Glazing, Insulation, Internal Lighting, HVAC and Hot Water is to be consistent with the recommendations of this report. Any changes to the performance of the above-mentioned components will have a direct effect on the predicted energy use and GHG emissions.

Energy simulation is a powerful analytical tool to test the performance of alternative design solutions. The outcome of each energy simulation run is dependent on a very large number of model input assumptions and the weather data file being used. Variance from the stated input data assumptions will have a direct effect on predicted energy use and greenhouse performance.