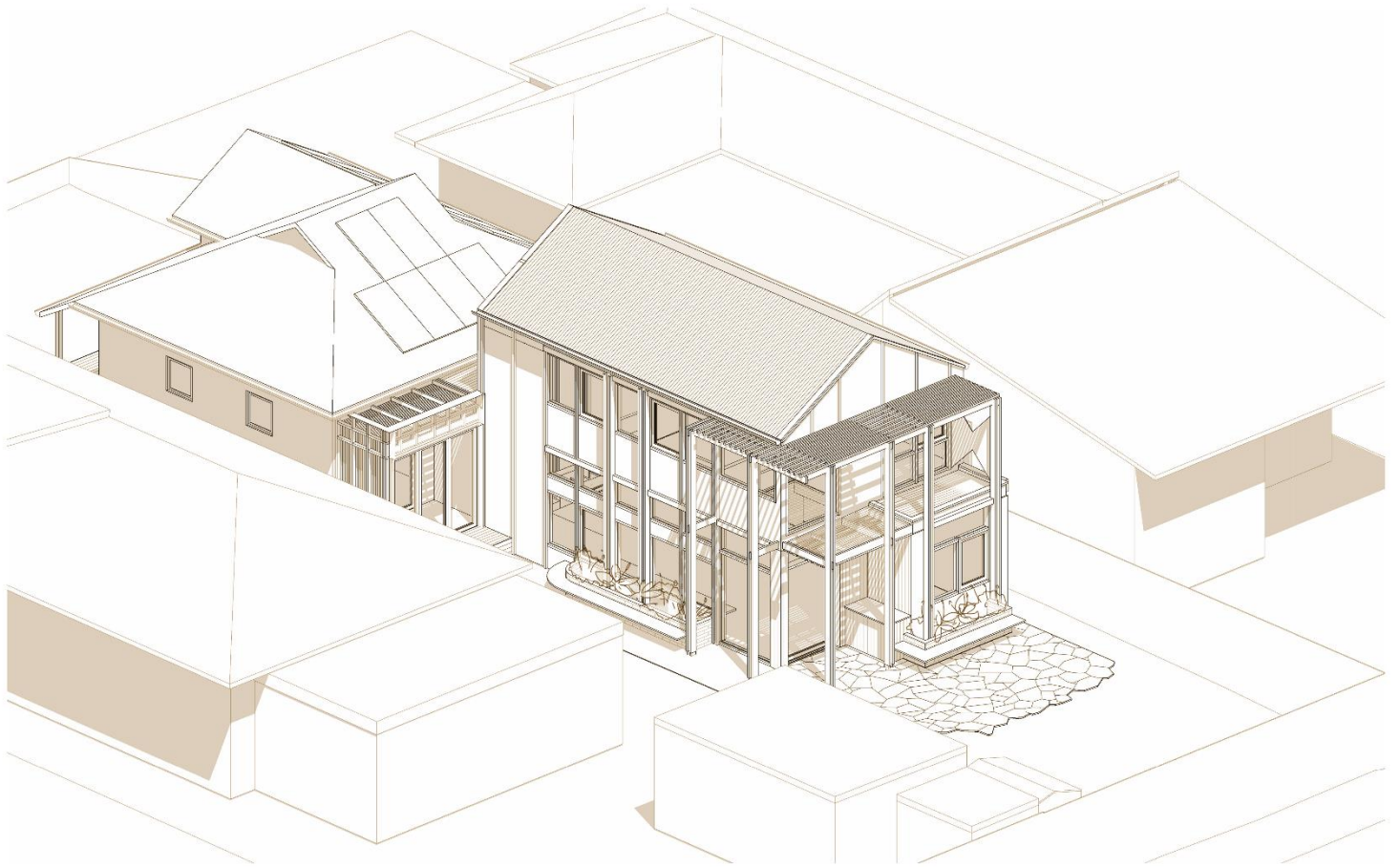




Low Impact Development
Consulting



Environmentally Sustainable Design

Life Cycle Analysis outcomes summary

Life Cycle

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12th March 2024

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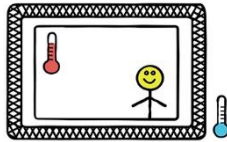
Version	Date	Description	Drawings	Prepared	Checked
1.0	12/03/2024	Construction drgs	Drgs recd 240130	CH	CH

Disclaimer

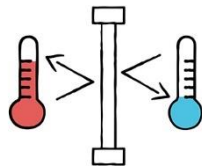
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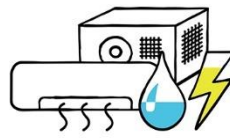
Development highlights



Well insulated building fabric



Improved energy efficiency - use of double glazed windows



Energy and water efficient heating and cooling



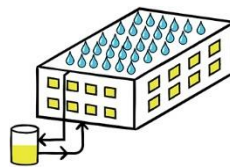
Energy efficient hot water heat pump systems



Energy and water efficient appliances



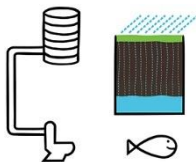
Renewable energy 7.6kW PV Panels - for common areas



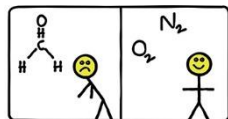
Potable (drinking) water savings - 4000L Rainwater tank connected to toilets and irrigation



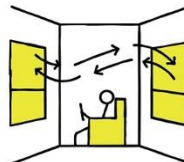
Potable (drinking) water efficient fixtures



Onsite water use and infiltration - Best Practice Stormwater treatment



Improved indoor air quality due to reduced use of off-gassing materials



Cross ventilation designed into all dwellings



Avoidance of use of rainforest timbers



Environmentally friendly materials choices



Retention of significant vegetation




Indoor clothes drying rails



Separate waste stream and recycling facilities

Contents

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 LID acknowledges and pays respect to the Australian Aboriginal and Torres Strait Islander people, to their ancestors and elders, past, present and emerging, as the traditional custodians of the lands upon which we work and live. We recognise Aboriginal and Torres Strait Islander people's deep cultural and spiritual relationships to the water, land and sea, and their rich contribution to society.

1 Summary

A life cycle analysis has been undertaken focusing on the lifetime carbon emissions of the redevelopment of Life Cycle, Coburg. The goal of this study is to profile and improve the environmental performance of the construction works at Life Cycle, Coburg.

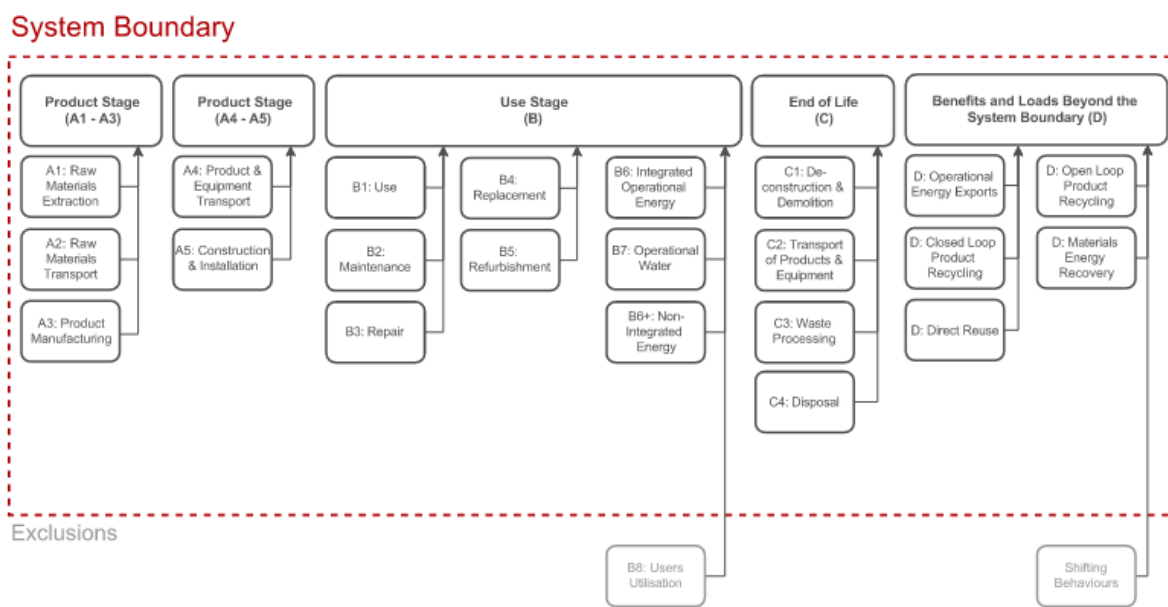
At the start of the process a 50% improvement was sought, and this was exceeded. The results of this analysis demonstrate that the redevelopment is estimated as achieving a 79% improvement on the eTool specified reference building. **The most significant element demonstrated in the report was value on the life cycle carbon emissions of increasing the solar PV capacity on the dwelling.**

Further, by getting to 9.1kW (additional 6.1 kW) solar PV capacity, and ensuring the generated electricity is fully used to replace non-renewable electricity, the emissions savings will fully offset the redevelopments calculated life time carbon emissions, and take the development to whole of life cycle net zero carbon.

The redevelopment substantially retains and refurbishes the existing double fronted weatherboard dwelling. A new living, dining and kitchen with upper level of two bedrooms and study will be added to the rear of the dwelling.

2 Background

Life cycle assessments are split into the following stages to meet the life cycle framework standards, and for ease of discussion.



Stages A1-A5 are considered the upfront carbon emissions. The total embodied carbon should be reduced by the choice of construction systems and materials options.

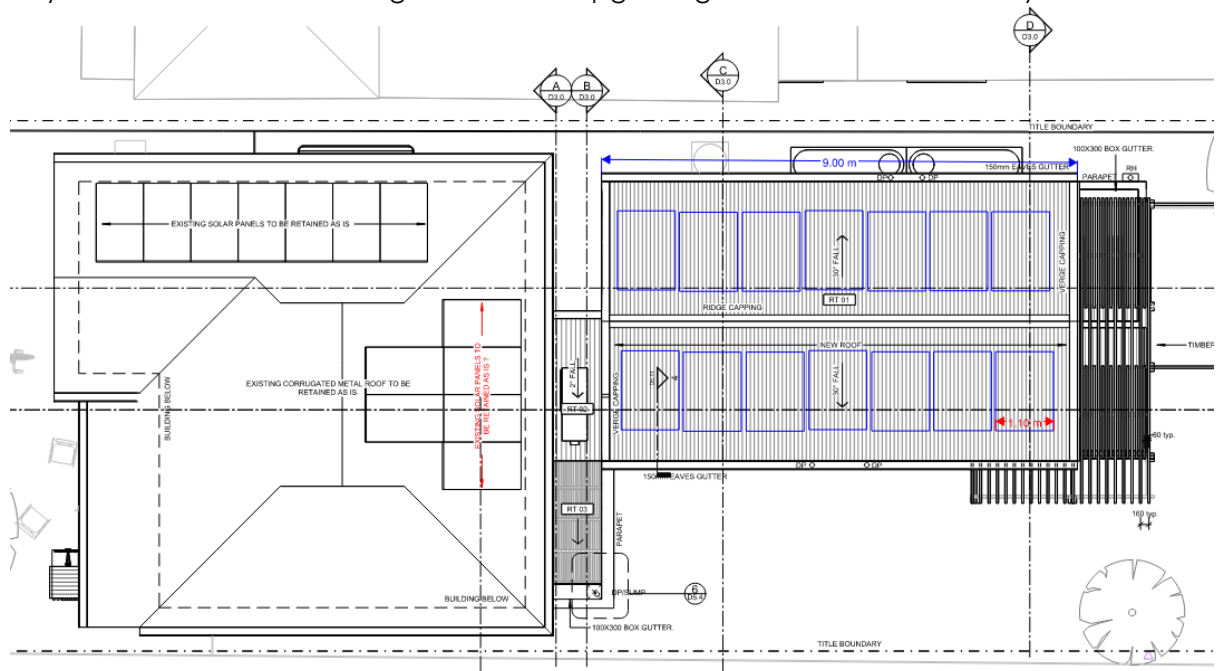
Stages B1-B7 represent emissions during the operational use of the building ie the majority of its lifetime. This period has traditionally been the time when most building related emissions are

generated, primarily from energy use but also significantly from maintenance and repair. It is also the time when the value of on site solar electricity generation can offset carbon emissions over a long period of time.

As buildings reduce the operational emissions from energy consumption, the earlier stages A1-A5 also become more significant in the push to reduce emission to buildings to net zero over their lifetime.

3 Key Inputs

1. With the existing 3kW solar the redevelopment achieved a 12% reduction in carbon emissions against the reference building.
2. Note the client has expressed a desire to add additional solar PV panels in the range of 5-10kW once their energy use is known. It has been estimated 14 additional panels of dimension 1.1m x 1.7m can be mounted at roof pitch to the new extension roof as shown below. Assuming 330W panels this equates to an additional 4.6kW added to the existing 3kW of panels to deliver 7.6kW. Increasing the solar to a total of 7.6kW gets a 79% reduction against the reference building. The greatest improvement beyond the reference building comes from upgrading the size of the solar PV system.



3. Blending a new house and existing house with existing window placement, challenges energy rating performance. Upgrading windows and insulation to walls has provided an energy rating of 6.3 stars overall.
4. 4000L rain water tank connected to toilets for flushing and gardens for irrigation as required.
5. Water efficient fixtures and appliances
 - a. 4 star toilets
 - b. 5 star bathroom tapware
 - c. 5.0 star water washing machine
 - d. 6.0 star water dishwasher

6. Drought proof garden with no irrigation system
7. Efficient services
 - a. high efficiency Daiken split system reverse cycle heat pump – aircon unit
 - b. efficient air source heat pump hydronic slab heating,
 - c. high efficiency heat pump storage hot water
 - d. efficient electric induction cooktop and electric oven
 - e. LED lighting
8. Taking measures to protect the environment – selection of the lowest possible Global Warming Potential (GWP) refrigerant gases. This is important because escaping refrigerant gases can be much more potent than carbon dioxide as green house warming gases – hence their much higher GWP numbers.
 - a. Daiken split system heat pump aircon units use R32 (GWP 675). Other manufacturers currently mainly use refrigerant with significantly higher GWP gases such as R134a (GWP 1430), or 410a (GWP 1890).
 - b. Heat pump hot water units using CO2 as the refrigerant (GWP 1). Typical other refrigerant options in heat pump hot water units include R32 (GWP 675), R134a (GWP 1430), 410a (GWP 1890)
9. Structure
 - a. Timber double glazed windows
 - b. New extension exposed concrete slab with 40% Portland cement replacement circular economy solution left over by-products from other industrial processes (eg slag/flyash)
10. Finishes
 - a. Kitchen and bathroom - standard
 - b. Stone to kitchen/dining/living

4 Analysis

Emissions for the entered data are as follows:

Carbon Emissions Global Warming Potential - GWP) by stage

Stage label	Stage name	kgCO2e
A1 - A3	Product Manufacture Stage	28,045.20
A4	Transport of Equipment and Materials	13,702.74
A5	Construction	3,584.11
B2 - B3	Maintenance and Repair	1,475.41
B4	Replacement	79,606.89
B6	Integrated Operational Energy Use	156,598.30
B6+	Non-integrated Energy	33,859.11
B7	Operational Water Use	10,619.03
C1	Deconstruction and Demolition	2,656.54
C2	Transport of Waste Offsite	1,691.76
C3	Waste Processing	560.51
C4	Disposal	10,910.85
D1	Operational Energy Exports	-241,937.00
D2	Closed Loop Recycling	-5,017.35
D3	Open Loop Recycling	-4,292.53
D4	Materials Energy Recovery	-67.21
Net carbon emissions (GWP)		91,996.35

Note by increasing the 7.6kW solar installation to 9.1kW capacity, the additional renewable energy generated (displacing emissions from non-renewable electricity) will offset the carbon emissions generated in the construction, maintenance and demolition of the development over its estimated lifetime. Note this calculation assumes the calculated emissions are accurate, and that all renewable electricity generated on site is able to be used. Note increasing total capacity to 9.1kW would effectively use all new and existing available roof space and perhaps require replacement of some of the existing solar panels.

Carbon emissions (Global Warming Potential - GWP) by building component

Building component	kgCO2e	Percentage of total emissions
HVAC Residential Heater, Hydronic Air Sourced Heat Pump	124,929	
Appliances, Residential Average Op&Em	117,103	
Split System Air Source Heat Pump for Cooling, high efficiency (COP/EER 4.2), R32 Refrigerant	85,056	
Refrigeration, Residential Average, Detailed, Op & Em	61,389	
High Efficiency Heat Pump with CO2 Refrigerant (HWS_App)	33,369	
Cooking, Res Electric Oven Induction Stove	32,100	
Floor Covering - Carpet, Tack Down Wool, Felt Underlay	18,668	
LED Residential Lighting (Standard Efficiency)	17,675	
Water Use and Treatment (eTool Turbo)	10,639	
LED Outdoor Lighting (Residential - Standard Efficiency), m2	8,784	
Standard 1st Bathroom - WC/Shower-bath/Basin/Wall Tiles	8,037	
Wall, Internal, Framed, Timber Stud Plasterboard and paint finish	6,837	
Windows, Residential Timber frame, Double Glaze	6,776	
Refurbish Ceiling, Internal, Replace Insulation, Plasterboard and Paint	5,326	
Lowest Floor - Concrete Slab, 100mm, 32MPa, 40% GGBS/BFS, 3.8% reo (m2)	4,975	
Roof - Timber Truss/Steel Sheeting/10° Pitch/plbrd finish	4,646	
Wall, External, Framed, Timber 90mm studs with battens, insulation, plasterboard and paint internal finish, coloured steel sheet cladding external	4,024	
Wall, External, Framed, Timber 90mm studs with battens, insulation, plasterboard and paint internal finish, fibre cement clad Hardie Linea™ (16mm)	3,865	
Utilities Connection to Site Residential	3,723	
Demolition - Residential (End-of-Life)	2,657	
Electrical Fittings - sockets power points wiring embodied only (m2)	2,437	
Elevated Floor, Timber Frame 250mm Bearers and Joists, <5m Span, particle board sheeting, insulated	2,172	
Kitchen Fittings, Furnishings & Equipment - medium sized	1,679	
Wall, External, Framed, Timber 90mm studs with battens, insulation, plasterboard and paint internal finish, hardwood clad stained	1,503	
Door - Solid Core Timber/Wooden Jam/Painted	1,481	
Water tank - coated steel above ground on gravel base	1,360	
Floor Covering - Flagstone (Sandstone, 10mm)	1,139	
Floor Covering - Tiles (ceramic/10mm)	1,052	
Kitchen Medium sized (incl Equipment)	1,046	
Deck, Elevated Timber on Steel Anchor (RapidLCA)	1,034	
Lowest Floor, Refurbished Raised Floor, New Insulation Only	793	
Lowest Floor, Timber Frame 140mm Joists and Bearers, <3m Span, particle board sheeting, insulated, on stumps	680	
Floor Covering - Refinishing existing timber floor floor	617	
Pool Structure - Concrete	522	
Staircase, Timber frame and timber treads	397	
Swimming Pool Seasonal Temperature Control - No Pool Cover - Gas	396	
Swimming Pool - Pumps and Filters Ultra Efficient	158	
Floor Covering - 19mm timber, nail down (superstructure)	-444	
Total of Emissions	578,598	
Solar PV System Residential - Zone 4 (Melb) - Offset to emissions	-486,602	-84%
Total net emissions	91,996	16%
Increase solar to 8.6 ie 8.6/7.6 x solar generated power	-549,947	-95%
Increase solar PV by 20% from 7.6kW ie to 9.1kW and the embodied emissions will be neutral.	-582,642	-101%

5 LCA notes

The **reference building** is set by the eTool program. The reference building used in Australia is based on an Australian benchmark that takes account of materials used in the typical vernacular types in each of the states, as well as free standing, townhouse and apartment buildings. This one benchmark is used for all dwellings so the performance of a single dwelling (for example its carbon emissions) is compared against the performance of an aggregated performance. This creates the challenge for single dwellings which might be expected to use more materials, to compare against a more materially efficient aggregated dwelling benchmark.

An **energy rating** can only be entered as a multiple of a half star ie 6.0, 6.5, 7.0, 7.5 stars etc. As achieving a 6.3 star rating when undertaken in 2022, a 6.0 star rating was entered into the tool.

The **bedroom numbers** and the census data for the postcode of the project help to determine the number of occupants attributed to the dwelling which impacts the LCA figures.

The study has been conducted in accordance with the following **standards**:

- International Standards 14040 and 14044.
- European Standard EN 15978: Sustainability of Construction Works – Assessment of Environmental Performance of Buildings – Calculation Method

However this LCA study has not been reviewed and as such does not meet the relevant section of the ISO14044 requirements. Caution should be taken when interpreting the LCA study report.

Cerclos / eTool disclaimer - The predictions of embodied and operational impacts (including costs) conducted in eTool software, by their very nature, cannot be exact. It is not possible to accurately track all the impacts associated with a product or service over the life of a building or structure. eTool software and the modelling workflow has been built and tested to enable informed decisions when comparing design options. Environmental impact coefficients and generic costs do not necessarily correspond to those of individual brands of the same product or service due to differences within industries in the way these products and services are delivered.



Appendix 1 - Cerclos Compliance report



Compliance Report Residence

Date: 6 March 2024
Author: Low Impact Development Consulting
Report Id: Uncontrolled Document

This LCA Study was conducted as part of the Coburg project. The LCA modeling within eTool is being managed by RapidLCA. For more information see contact details below.

RapidLCA
18 Howard St Perth
info@etoolglobal.com
(08)9467 1664

eTool Disclaimer

The predictions of embodied and operational impacts (including costs) conducted in eTool software, by their very nature, cannot be exact. It is not possible to accurately track all the impacts associated with a product or service over the life of a building or structure. eTool software and the modelling workflow has been built and tested to enable informed decisions when comparing design options. Environmental impact coefficients and generic costs do not necessarily correspond to those of individual brands of the same product or service due to differences within industries in the way these products and services are delivered.

This LCA study has not been reviewed and as such does not meet the relevant section of the ISO14044 requirements. Caution should be taken when interpreting the LCA study report.

eTool PTY LTD cannot make assurances regarding the accuracy of these reports for the above reasons.

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1 Performance Summary



Global Warming Potential Total, GWP Life Cycle



79% Saving against benchmark

2 Performance Detail

Design Comparison

Global Warming Potential Total, GWP (kg CO₂ eq / Occupants (#) / Per Year) Life Cycle

Reference Design	3210.86
Proposed Design	669.06

Life Cycle Module Comparison

	Initial Materials & Construction (A1-A5)	Use Stage Materials & Construction (B1-B5)	Integrated Energy Use (B6)	Plug Load Energy Use (B6+)	Water Supply & Treatment (B7)	End of Life (C1-C4)	Recycling & Energy Export (D)	Biogenic	Total
Global Warming Potential Total, GWP (kg CO₂ eq / Occupants (#) / Per Year) Life Cycle									
Reference Design	439.11	378.89	1402.17	940.96	87.47	56.8	-28.33	-66.22	3210.86
Proposed Design	460.65	581.02	1136.46	245.72	63.67	41.35	-1836.33	-23.47	669.06
Contribution to Life Cycle Savings	-1%	-6%	8%	22%	1%	0%	56%	-1%	79%

3 Model Risk Summary

The Model Risk Summary table lists all changes to the current design when compared to its original baseline and ranks these changes by potential risk, from highest to lowest risk score.

Important Notes

- The levels of risk are applied according to historical data trends and may fall within your organisation’s allowances for baseline deviation.
- While we use the term Risk Assessment, the changes highlighted may not actually constitute a threat of loss to the project or organisation.

Changes	Risk Level
Config Quantity Modified: GrossFloorArea	60.72
Config Quantity Modified: Bedrooms	18
Template Quantity Modified: Dwellings	12
Template Quantity Modified: Glazed Area	11.34
Template Swapped: Solar PV System Residential - Zone 4 (Melbourne, Hobart, Albany)	10.5
Config Quantity Modified: HeatingDemand	10.49
Template Quantity Modified: Cooling System	8.4
Template Quantity Modified: Upper Floor Area	5.76
Config Quantity Modified: CoolingDemand	5.45
Config Quantity Modified: CeilingHeight	4.8
Template Swapped: High Efficiency Heat Pump with CO2 Refrigerant (HWS_App)	4.5
Template Quantity Modified: Outdoor Lighting Fitout	3.01
Template Swapped: Windows, Residential Timber frame, Double Glaze	3
Template Swapped: Wall, Internal, Framed, Timber Stud Plasterboard and paint finish	3
Template Quantity Modified: External Wall Area	2.47
Template Swapped: Kitchen Fittings, Furnishings & Equipment - medium sized	1.5
Template Swapped: Standard 1st Bathroom - WC/Shower-bath/Basin/WallTiles	1.5
Template Swapped: Wall, External, Framed, Timber 90mm studs with battens, insulation, plasterboard and paint internal finish, fibre cement clad Hardie Linea™ (16mm)	1.5
Template Swapped: Wall, External, Framed, Timber 90mm studs with battens, insulation, plasterboard and paint internal finish, hardwood clad stained	1.5
Template Swapped: Wall, External, Framed, Timber 90mm studs with battens, insulation, plasterboard and paint internal finish, coloured steel sheet cladding external	1.5
Template Swapped: HVAC Residential Heater, Hydronic Air Sourced Heat Pump	1.5

Template Swapped: HVAC Residential Heater, Hydronic Air Sourced Heat Pump	1.5
Template Swapped: Split System Air Source Heat Pump for Cooling, high efficiency (COP/EER 4.2), R32 Refrigerant	1.5
Template Swapped: Split System Air Source Heat Pump for Cooling, high efficiency (COP/EER 4.2), R32 Refrigerant	1.5
Template Quantity Modified: Internal Wall Area	1.03
Template Quantity Modified: Living Area	0.5
Template Quantity Modified: Roof Area	0.23
Template Quantity Modified: Bedroom Area	0.18
Template Quantity Modified: Wet Area	0.13
Template Quantity Modified: Kitchens Dining Area	0.13
Template Swapped: Floor Covering – Carpet, Tack Down Wool, Felt Underlay	0.12
Template Swapped: Floor Covering – 19mm timber nail down (superstructure)	0.12
Template Swapped: Floor Covering – Flagstone (Sandstone, 10mm)	0.12
Template Swapped: Floor Covering – Tiles (ceramic/10mm)	0.12
Template Swapped: Roof – TimberTruss/SteelSheeting/10°Pitch/plbrd finish	0.12
Template Swapped: Refurbish Ceiling, Internal, Replace Insulation, Plasterboard and Paint	0.12
Template Swapped: Staircase, Timber frame and timber treads	0.12
Template Swapped: Cooking, Res Electric Oven Induction Stove	0.12
Config Quantity Modified: Bathrooms	0.1

4 Building Attributes

Highlighted information denotes that changes were made from the "baseline design" and should be an area of focus for compliance checks.

Coburg

Dwellings	1
Bedrooms	3
Bathrooms	2
Car parks	0
Floors	2
Type of carpark	Other
Ceiling Height	2.7
Gross Floor Area	170
Occupancy Date	01/09/2023

Energy Supply and Efficiency Attributes

Electricity Supply	Mains Connected
Cooling Demand	20
Heating Demand	118
Thermal Rating	NatHERS 6.0 Star
Thermal Unit	MJ / m2
Energy Monitoring	No Energy Monitoring
Natural Lighting	Normal

Water Supply and Efficiency Attributes

Water Supply	Rain Water Supplemented – All Garden and Toilet Demand
Water Treatment	Mains Connected
Shower Heads	3 Star (greater than 7.5 and less than or equal to 9.0 L/m)
Toilets	4 star (4.7L/flush, 3.2/half flush, 3.5L/average flush)
Tapware	5 Star (greater than 4.5 and less than or equal to 6.0 L/m)
Washing Machine	5.0 star (7.5L/kg clothing washed)
Dishwasher	6.0 star (7.07L/wash for 10 place setting dishwasher)
Garden Type	Drought proof garden, zero irrigation
Rainwater Pump Type	Undefined

5 Building Components

Highlighted information denotes that changes were made from the "baseline design" component type, or changes were made to the default quantities and should be an area of focus for compliance checks.

Integrated Services

Component Attribute and Selection	Modelled Quantity	Expected Quantity
Cooking Appliances		
Cooking, Res Electric Oven Induction Stove	1 #	1 #
Hot Water System		
High Efficiency Heat Pump with CO2 Refrigerant (HWS_App)	1 #	1 #
Indoor Lighting Fitout		
LED Residential Lighting (Standard Efficiency)	1 #	1 #
Cooling System		
Split System Air Source Heat Pump for Cooling, high efficiency (COP/EER 4.2), R32 Refrigerant	DELETED	
Split System Air Source Heat Pump for Cooling, high efficiency (COP/EER 4.2), R32 Refrigerant	2.4 #	1 #
Heating System		
HVAC Residential Heater, Hydronic Air Sourced Heat Pump	DELETED	
HVAC Residential Heater, Hydronic Air Sourced Heat Pump	1 #	1 #

Plug Loads

Component Attribute and Selection	Modelled Quantity	Expected Quantity
Refrigeration		
Refrigeration, Residential Average, Detailed, Op & Em	1 #	1 #
Appliances		
Appliances, Residential Average Op&Em	1 #	0 #

Outdoor Services

Component Attribute and Selection	Modelled Quantity	Expected Quantity
Water tank		
Water tank – coated steel above ground on gravel base	4000 L	17500 L
Renewable Generation		
Solar PV System Residential – Zone 4 (Melbourne, Hobart, Albany)	7.6 kW	1 kW
Outdoor Lighting Fitout		
LED Outdoor Lighting (Residential – Standard Efficiency), m2	103.74 m2	208.21 m2
Swimming Pool Temperature Control		
Swimming Pool Seasonal Temperature Control – No Pool Cover – Gas	0 m2	0 m2
Swimming Pool Filtering		
Swimming Pool – Pumps and Filters Ultra Efficient	0 m2	0 m2
Swimming Pool		
Pool Structure – Concrete	0 m2	0 m2

Structure

Component Attribute and Selection	Modelled Quantity	Expected Quantity
Ground Floor Area		
Lowest Floor – Concrete Slab, 100mm, 32MPa, 40% GGBS/BFS, 3.8% reo (m2)	51.51 m2	
Lowest Floor, Refurbished Raised Floor, New Insulation Only	70.2 m2	95.06 m2
Lowest Floor, Timber Frame 140mm Joists and Bearers, <3m Span, particle board sheeting, insulated, on stumps	8.4 m2	
Upper Floor Area		
Elevated Floor, Timber Frame 250mm Bearers and Joists, <5m Span, particle board sheeting, insulated	39 m2	74.94 m2
Stairs		
Staircase, Timber frame and timber treads	1 #	1 #
External Wall Area		
Wall, External, Framed, Timber 90mm studs with battens, insulation, plasterboard and paint internal finish, fibre cement clad Hardie Linea™ (16mm)	62.58 m2	
Wall, External, Framed, Timber 90mm studs with battens, insulation, plasterboard and paint internal finish, hardwood clad stained	4.3 m2	187.39 m2
Wall, External, Framed, Timber 90mm studs with battens, insulation, plasterboard and paint internal finish, coloured steel sheet cladding external	43.46 m2	
Glazed Area		
Windows, Residential Timber frame, Double Glaze	64.81 m2	33.32 m2
Roof Area		
Roof – TimberTruss/SteelSheeting/10°Pitch/plbrd finish	63.4 m2	
Refurbish Ceiling, Internal, Replace Insulation, Plasterboard and Paint	95.43 m2	109.32 m2
Entry Doors		
Door – SolidCoreTimber/WoodenJam/Painted	1 #	2 #
Internal Doors		
Door – SolidCoreTimber/WoodenJam/Painted	8 #	7 #
Internal Wall Area		
Wall, Internal, Framed, Timber Stud Plasterboard and paint finish	63 m2	
Wall, Internal, Framed, Timber Stud Plasterboard and paint finish	DELETED	124.31 m2
Wall, Internal, Framed, Timber Stud Plasterboard and paint finish	72 m2	

Finishes

Component Attribute and Selection	Modelled Quantity	Expected Quantity
Living Area		
Floor Covering - 19mm timber, nail down (superstructure)	DELETED	51.68 m2
Kitchens Dining Area		
Floor Covering - Flagstone (Sandstone, 10mm)	47.3 m2	63.31 m2
Wet Area		
Floor Covering - Tiles (ceramic/10mm)	10.6 m2	14.21 m2
Bedroom Area		
Floor Covering - Carpet, Tack Down Wool, Felt Underlay	55.5 m2	40.8 m2
Other		
Floor Covering - Refinishing existing timber floor floor	29.8 m2	
Deck, Elevated Timber on Steel Anchor (RapidLCA)	17 m2	0 m2
Floor Covering - Flagstone (Sandstone, 10mm)	23.15 m2	
Floor Covering - 19mm timber, nail down (superstructure)	14.2 m2	
Dwellings		
Kitchen Fittings, Furnishings & Equipment - medium sized	1 #	
Standard 1st Bathroom - WC/Shower-bath/Basin/WallTiles	2 #	1 #

