Low Impact Development Consulting

Environmentally Sustainable Design Life Cycle Analysis outcomes summary Cloud Street

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1.0	22/03/2024	Construction drawings	Drgs recd 240312	ZZ	СН
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Development highlights



Well insulated building fabric



Improved energy efficiency - use of double glazed windows



Potable (drinking) water efficient fixtures



Energy efficient hot water heat pump systems



Energy and water efficient appliances



Renewable energy 17kW PV Panels - for common areas



Potable (drinking) water savings – 12,000L Rainwater tank connected to toilets and irrigation



Onsite water use and infiltration -Best Practice Stormwater



Environmentally friendly materials choices



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

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Cross ventilation designed into all dwellings



Avoidance of use of rainforest timbers



Separate waste stream and recycling facilities



Retention of significant vegetation

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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 *Cloud Street*. The goal of this study is to profile and improve the environmental performance of the construction works at *Cloud Street*, *Northcote*.

The results of this analysis demonstrate that the redevelopment is **a substantially carbon positive development over its lifetime**, demonstrated by the 230% improvement on the eTool specified reference building. A score above 100% goes beyond the development being carbon neutral, to being carbon positive – where the renewable energy generated exceeds the embodied and operational carbon generated over its full lifecycle.

The most significant key factor in the building being carbon positive is the very substantial solar PV array of 17kW capacity. Other contributing factors are the high efficiency heating, cooling, and hot water systems.

The development is a new two storey dwelling comprising living room, kitchen, 3 bedrooms, study, play room, guest room, garage and workshop. The building is timber framed with predominantly hardwood cladding, including some rammed earth walls internally. The ground floor is generally polished concrete finish.

2 Background

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



System Boundary

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. A 17kW solar PV system is installed on the roof, resulting in a 230% reduction against the reference building. The greatest improvement against the reference building comes from the very large solar PV system.



- 2. By incorporating passive solar design, high levels of insulation and efficient doubleglazing windows, the dwelling achieves an energy rating of 7.2 stars overall.
- 3. Rain water tanks of 3 x 4000L are connected to toilets for flushing and gardens for irrigation when required.
- 4. Water efficient fixtures and appliances
 - a. 4 star toilets
 - b. 5 star bathroom tapware
 - c. 4.5 star water washing machine
 - d. 5.5 star water dishwasher
- 5. Drought proof garden with no irrigation system
- 6. Efficient services
 - a. Heating efficient air source heat pump hydronic slab heating
 - b. Hot water high efficiency heat pump storage hot water
 - c. Cooking efficient electric induction cooktop and electric oven
 - d. Lighting LED lighting throughout



- Taking measures to protect the environment selection of relevant appliances with the lowest possible Global Warming Potential (GWP) refrigerant gases. This is important because escaping refrigerant gasses can be much more potent than carbon dioxide as green-house warming gases – hence their much higher GWP numbers.
 - a. 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)
- 8. Structure
 - a. Timber double glazed windows
 - b. Concrete slab with 40% Portland cement replacement circular economy solution left over by-products from other industrial processes (eg slag/flyash)
- 9. Finishes
 - a. Kitchen and bathroom standard
 - b. Polished concrete floor to kitchen/dining/living/workshop

4 Analysis

Emissions for the entered data are as follows:

Carbon emissions (Global Warming Potential - GWP) by stage		
Stage Label	Stage Name	kgCO2e
A1A3	Product Stage	48,761
A4	Transport of Equipment and Materials	26,526
A5	Construction	7,912
B1	General Use	-106
B4	Replacement	142,533
B6	Integrated Operational Energy Use	-148,684
B6+	Non-integrated Energy	-134,548
B7	Operational Water Use	8,728
C1	Deconstruction and Demolition	2,657
C2	Transport of Waste Offsite	4,689
C3	Waste Processing	1,254
C4	Disposal	27,248
D1	Operational Energy Exports	-541,175
D2	Closed Loop Recycling	-8,426
D3	Open Loop Recycling	-9,602
D4	Materials Energy Recovery	-139
Net of exporte	ed energy exceeding emissions (carbon positive outcome	-572,373

Note by providing the 17kW solar instalalition, the renewable energy generated (displacing emisions from non-renewable electricity) will offset the carbon emissions generated in the contruction, maintenance and demoliton 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 onsite or exported and used offsite.

Carbon emissions (Global Warming Potential - GWP) by building component			
Building Component	kgCO2e		
Appliances, Residential Average Op&Em	117,103		
HVAC Residential Heater, Hydronic Air Sourced Heat Pump	70,538		
Refrigeration, Residential Average, Detailed, Op & Em	61,389		
Floor Covering - Carpet, Tack Down Wool, Felt Underlay	43,230		
Cooking, Res Electric Oven Induction Stove	32,100		
LED Residential Lighting (Standard Efficiency)	31,742		
High Efficiency Heat Pump with CO2 Refrigerant (HWS_App)	26,197		
Wall, External, Framed, Timber 90mm studs with battens, insulation, plasterboard and paint internal finish, hardwood clad stained	22,844		
Lowest Floor - Concrete Slab, 100mm, 25MPa, 3.8% reo (m2)	14,760		
Wall, Internal, Framed, Timber Stud Plasterboard and paint finish	11,222		
Water Use and Treatment (eTool Turbo)	8,748		
Windows, Residential Timber frame, Double Glaze	8,389		
Elevated Floor, Timber Frame 250mm Bearers and Joists, <5m Span, particle board sheeting, insulated	8,236		
Water tank - steel (embodied)	8,136		
Roof - TimberTruss/SteelSheeting/15°Pitch	7,833		
Roof - TimberTruss/SteelSheeting/10°Pitch/plbrd finish	5,967		
Wall, External, Rammed Earth Wall (In situ Earth) 300mm including foundations	5,256		
LED Outdoor Lighting (Residential - Standard Efficiency), m2	4,213		
Wall, Internal, Rammed Earth Wall (In situ Earth) 300mm including foundations	3,855		
Utilities Connection to Site Residential	3,723		
Standard 1st Bathroom - WC/Shower-bath/Basin/WallTiles	3,559		
Roof - TimberTruss/SteelSheeting/5°Pitch/RakingCeiling	2,855		
Demolition - Residential (End-of-Life)	2,657		
Electrical Fittings - sockets power points wiring embodied only (m2)	2,437		
Roof - TimberTruss/SteelSheeting/30°Pitch	2,072		
External Wall Insulation - Fibreglass, 90mm (R2, m2)	1,458		
Floor Finish - Grind+Polished Concrete	1,394		
Door - SolidCoreTimber/WoodenJam/Painted	1,332		
Kitchen Medium sized (incl Equipment)	1,046		
Floor Covering - Tiles (ceramic/5mm)	851		
Staircase, Timber frame and timber treads	794		
Internal Wall - Framing, 90mm Timber Stud (400mm centres)	59		
Total emissions	515,994		
Solar PV System Residential - Zone 4 (Melbourne, Hobart, Albany)	-1,088,367		
Totals	-572.373		

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 mateirals 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 7.2 star rating, a 7.0 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.

Operational carbon figures overstated - The embodied carbon for electricity is calculated locally and is determined when the project address is set. Currently, the grids are out of date by approximately 2-3 years. In the last few years, the renewables component of the grid has



increased, hence the operational carbon component of grid electricity reduced. The Cerclos development team is working on updating the grid values. This should occur by mid 2024.

Note while the operational carbon figures are overstated, the embodied carbon figures would not be affected as much. This is because the energy consumed in the production and delivery of major materials is often not predominantly electricity. Where coal, gas, chemical reactions and petrol/diesel are the most significant energy sources used in the manufacture, transport and assembly of materials, decarbonising the electric grid does not as significantly help to reduce the embodied carbon. This is the case for major building materials such as steel and concrete production (cement relies on a chemical reaction to create clinka from limestone – to drive off CO2 from the limestone).

Compliance with international standards - 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: 25 March 2024 Author: Low Impact Development Consulting Report Id: Uncontrolled Document



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

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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. © 2024 eTool PTY LTD, RapidLCA All rights reserved.







1 Performance Summary



Global Warming Potential Total, GWP Life Cycle

230% Saving against benchmark

2 Performance Detail

Design Comparison

Global Warming Potential Total, G	WP (kg CO2 eq / Occupants (#) / Per Year) Life Cycle	
Reference Design		3210.86
Proposed Design		-4162.71

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 SupplyE & Treatment (B7)	nd of Life (C1– C4)	Recycling & Energy Export (D)	Biogenic	Total
Global Warm	ing Potential T	otal, GWP (kg	CO ₂ eq / Oc	cupants (#) /	/ Per Year) Life	e Cycle			
Reference Design	439.11	378.89	1402.17	940.96	87.47	56.8	-28.33	-66.22	3210 <mark>.</mark> 86
Proposed Design	956.02	985.39	-1079.02	-976.43	52.28	73.61	-4085.09	-89.48	-4162.71
Contribution to Life Cycle Savings	-16%	-19%	77%	60%	1%	-1%	126%	1%	230%





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	207.13
Config Quantity Modified: HeatingDemand	28.41
Config Quantity Modified: Bedrooms	18
Config Quantity Modified: CoolingDemand	17.15
Config Quantity Modified: CeilingHeight	10.8
Template Swapped: Solar PV System Residential - Zone 4 (Melbourne, Hobart, Albany)	10.5
Template Swapped: Solar PV System Residential - Zone 4 (Melbourne, Hobart, Albany)	10.5
Template Swapped: Internal Wall - Framing, 90mm Timber Stud (400mm centres)	7.5
Template Quantity Modified: Cooling System	6
Template Quantity Modified: Outdoor Lighting Fitout	5. <mark>1</mark> 6
Template Swapped: High Efficiency Heat Pump with CO2 Refrigerant (HWS_App)	4. 5
Template Quantity Modified: External Wall Area	<mark>3</mark> .21
Template Swapped: Windows, Residential Timber frame, Double Glaze	3
Template Swapped: Wall, Internal, Rammed Earth Wall (In situ Earth) 300mm including foundations	3
Template Quantity Modified: Glazed Area	2.36
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, Rammed Earth Wall (In situ Earth) 300mm including foundations	1.5
Template Swapped: External Wall Insulation - Fibreglass, 90mm (R2, m2)	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: 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: Pool structure - fibreglass	1.5



Template Swapped: Swimming Pool Seasonal Temperature Control - Manual Pool Cover - Heat Pump Standard Efficiency COP 4	1.5
Template Quantity Modified: Internal Wall Area	0.75
Template Quantity Modified: Stairs	0.5
Template Quantity Modified: Kitchens Dining Area	0.5
Template Quantity Modified: Living Area	0.5
Template Quantity Modified: External Wall Area Ground Level	0.47
Template Swapped: Floor Covering - Carpet, Tack Down Wool, Felt Underlay	0.12
Template Swapped: Floor Finish - Grind+Polished Concrete	0.12
Template Swapped: Floor Finish - Grind+Polished Concrete	0.12
Template Swapped: Roof - TimberTruss/SteelSheeting/10°Pitch/plbrd finish	0.12
Template Swapped: Roof - TimberTruss/SteelSheeting/15°Pitch	0.12
Template Swapped: Roof - TimberTruss/SteelSheeting/30°Pitch	0.12
Template Swapped: Roof - TimberTruss/SteelSheeting/5°Pitch/RakingCeiling	0.12
Template Swapped: Staircase, Timber frame and timber treads	0.12
Template Swapped: Cooking, Res Electric Oven Induction Stove	0.12
Template Swapped: Swimming Pool - Pumps and Filters High Efficiency	0.12
Template Quantity Modified: Wet Area	O.11
Template Quantity Modified: Roof Area	0.08
Template Quantity Modified: Bedroom Area	0.08





4 Building Attributes

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

Northcote

Dwellings	1	
Bedrooms	3	
Bathrooms	2.5	
Car parks	2	
Floors	2	
Type of carpark	Garage	
Type of carpark <mark>Ceiling Height</mark>	Garage 2.95	
Type of carpark Ceiling Height Gross Floor Area	Garage 2.95 341.9	

Energy Supply and Efficiency Attributes

Electricity Supply	Mains Connected
Cooling Demand	15.7
Heating Demand	75.3
Thermal Rating	NatHERS 7.0 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	4 Star (less than or equal to 6.0 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	4.5 star (9.5L/kg clothing washed)
Dishwasher	5.5 star (7.78L/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	1#
Heating System		
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#	O #





Outdoor Services

Component Attribute and Selection	Modelled Quantity	Expected Quantity
Water tank		
Water tank - steel (embodied)	12000 L	17500 L
Renewable Generation		
Solar PV System Residential - Zone 4 (Melbourne, Hobart, Albany)	DELETED	1 kW
Solar PV System Residential - Zone 4 (Melbourne, Hobart, Albany)	17 kW	
Outdoor Lighting Fitout		
LED Outdoor Lighting (Residential - Standard Efficiency), m2	49.1 m2	352.42 m2
Swimming Pool Temperature Control		
Swimming Pool Seasonal Temperature Control - Manual Pool Cover - Heat Pump Standard Efficiency COP 4	DELETED	0 m2
Swimming Pool Filtering		
Swimming Pool - Pumps and Filters High Efficiency	DELETED	0 m2
Swimming Pool		
Pool structure - fibreglass	DELETED	0 m2





Structure

Component Attribute and Selection	Modelled Quantity	Expected Quantity
Ground Floor Area		
Lowest Floor - Concrete Slab, 100mm, 25MPa, 3.8% reo (m2)	150.3 m2	184.45 m2
Upper Floor Area		
Elevated Floor, Timber Frame 250mm Bearers and Joists, <5m Span, particle board sheeting, insulated	157.45 m2	157.45 m2
Stairs		
Staircase, Timber frame and timber treads	2 #	1#
External Wall Area		
Wall, External, Framed, Timber 90mm studs with battens, insulation, plasterboard and paint internal finish, hardwood clad stained	184 m2	
Wall, External, Rammed Earth Wall (In situ Earth) 300mm including foundations	34.3 m2	346.55 m2
External Wall Insulation - Fibreglass, 90mm (R2, m2)	184 m2	
Wall, External, Framed, Timber 90mm studs with battens, insulation, plasterboard and paint internal finish, hardwood clad stained	129.5 m2	
Glazed Area		
Windows, Residential Timber frame, Double Glaze	80.21 m2	67.01 m2
Roof Area		
Roof - TimberTruss/SteelSheeting/10°Pitch/plbrd finish	81.7 m2	
Roof - TimberTruss/SteelSheeting/15°Pitch	100.5 m2	010.100
Roof - TimberTruss/SteelSheeting/30°Pitch	25.9 m2	212.12 1112
Roof - TimberTruss/SteelSheeting/5°Pitch/RakingCeiling	38.7 m2	
Entry Doors		
Door - SolidCoreTimber/WoodenJam/Painted	2 #	2 #
Internal Doors		
Door - SolidCoreTimber/WoodenJam/Painted	16 #	7.5 #
Internal Wall Area		
Wall, Internal, Framed, Timber Stud Plasterboard and paint finish	DELETED	
Wall, Internal, Framed, Timber Stud Plasterboard and paint finish	234.9 m2	273 16 m2
Wall, Internal, Rammed Earth Wall (In situ Earth) 300mm including foundations	21.3 m2	270.10 112
External Wall Area Ground Level		
Internal Wall - Framing, 90mm Timber Stud (400mm centres)	184 m2	186.96 m2



Finishes

Component Attribute and Selection	Modelled Quantity	Expected Quantity
Living Area		
Floor Finish - Grind+Polished Concrete	DELETED	92.99 m2
Kitchens Dining Area		
Floor Finish - Grind+Polished Concrete	DELETED	113.92 m2
Wet Area		
Floor Covering - Tiles (ceramic/5mm)	19.9 m2	25.57 m2
Bedroom Area		
Floor Covering - Carpet, Tack Down Wool, Felt Underlay	85.3 m2	73.42 m2
Other		
Floor Covering - Carpet, Tack Down Wool, Felt Underlay	44 m2	0 m2
Floor Finish - Grind+Polished Concrete	205 m2	0 mz





