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Finding a Better Way

Victoria House Upfront Carbon Assessment Report

Montario Quarter Pty Ltd (HESPERIA)

J000622

EXECUTIVE SUMMARY

This Upfront Carbon Assessment summary displays the results from Victoria House study which is comprised of a retrofitted double storey building and construction of three residential towers by Montario Quarter Pty Ltd, a subsidy of Hesperia. The calculation method follows Green Star Guidance for Upfront Carbon for Buildings and is in accordance with EN 15978:2011.

The following report details the goal & scope, system boundary, lifecycle Inventory, key assumptions, results and interpretation and references to all evidence documentation and guidelines and standards.

Upfront Carbon Impact Summary

Metric	Result
Reference / Base Case Upfront Carbon Footprint (T CO2e)	9,947
As Constructed / Actual Upfront Carbon Footprint (T CO2e)	9,484
Percentage Carbon Reduction (%)	4.7%
GWP intensity of construction (kgCO2e/m2 GFA)	447

Results by Module

LCA Module	A1-A3	A4	A5
Module Description as per EN15978	Raw material extraction, transport, and manufacturing	Transport to site	Construction and installation
Reference / Base Case (T CO2e)	8,957	299	692
As Constructed / Actual Case (T CO2e)	8,561	293	630

Top Contributors

Impact	Module	Quantity (TCO2e)	Relative Reduction (%)
Insitu Concrete - Grade N32	A1-A3	2,041	6
Reinforcement Metal - Steel Bar	A1-A3	2,039	6.5
Construction - Energy Use - Site Electricity Consumption	A5	483	0
Roof and Wall Cladding - Brickwork 90mm Facebrick (Double skin)	A1-A3	619	9.1
Electrical Services Package	A1-A3	614	0

As part of the project an old hospital building was refurbished, the results for this building in isolation are shown in the figure below.

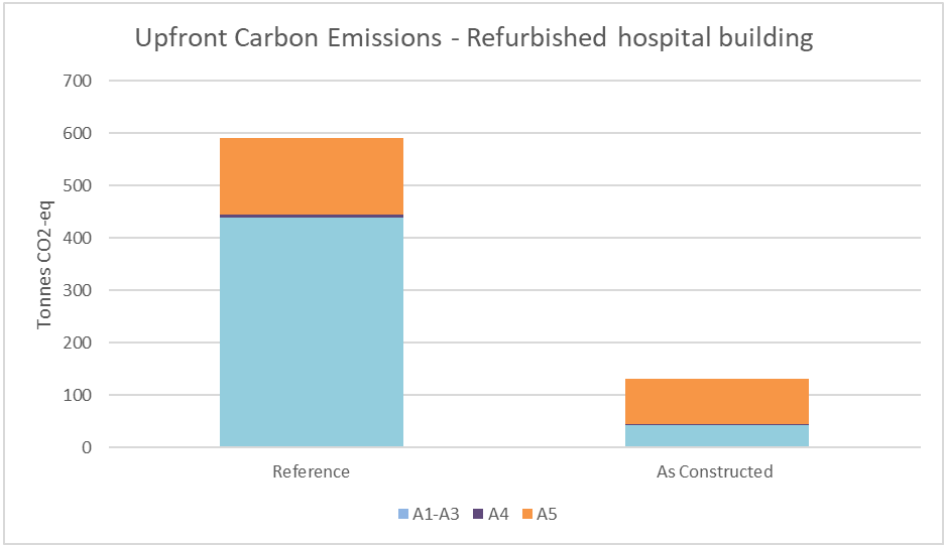

Figure 1 - Refurbished building results

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Rev No	Date	Revision Details	Author	Reviewed By
A	09/11/23	Draft for Internal Review; To be read in conjunction with LCA Model Rev A (spreadsheet)	Jamie Brown	Patrick Jeannerat
0	16/11/23	To be read in conjunction with LCA Model Rev 0 (spreadsheet)	Jamie Brown	Patrick Jeannerat
1	12/12/23	Revised in response to Hesperia comments	William Westaway	Patrick Jeannerat

1 GOAL & SCOPE

The goal of this study is to quantify the upfront carbon of the Victoria House, comprised of a double storey retrofitted hospital building (with a GFA of 1,959m2 repurposed for medical and hospitality) and three adjacent multi-storey residential blocks providing a GFA of 18,584m2. The materials inventory was quantified by WT Partners and has fed directly into Perspektiv's upfront carbon assessment model.

The purpose of this upfront carbon assessment is to quantify the emissions reductions gained from reusing parts of the existing building (As Constructed Case) as opposed to full demolition and complete reconstruction (Reference Case). The scenarios for assessment are summarised in the following table, each scenario has been modelled separately.

Scenario	Description
Reference Case (Base Case)	• Hypothetical business-as-usual complete demolition and construction • Assumes no reclaimed materials
As Constructed Case (Actual Case)	• Informed by actual demolition and construction quantities • Includes benefits of reclaimed materials from the old hospital building: Reinforced concrete floor slab and foundations (465m3 concrete and 85t reinforcing steel), brick wall (900m2), 146t timber roof framing, 23 solid core timber door framing, 1459m2 steel roofing.

Table 1 - Scenarios assessed in the LCA.

1.1 Guidelines & Standards

This study is assessed under Modules A1-A5 under EN15978: Sustainability of construction works - Assessment of environmental performance of buildings - Calculation method. Assumptions made are in line with the Green Star Upfront Carbon Emissions Calculation Guide developed by the Green Building Council of Australia.

1.2 System Boundary

The figure on the following page illustrates the scope of the upfront carbon assessment conducted for this building, and how it aligns with the coverage required under the Climate Active Upfront Carbon for Buildings Guideline in reference to the assessment framework of EN 15978:2011.

1.3 Exclusions

It is noted that no tenancy interior fit-out works have been included in this assessment.

1.4 Peer Review

This Upfront Carbon Study has been peer reviewed by Patrick Jeannerat, qualified as LCA Certified Practitioner by ALCAS. The peer review was conducted in accordance with ISO14044 and relevant critical review criteria in ISO/TS 14071. Refer to separate critical review report issued alongside this document.

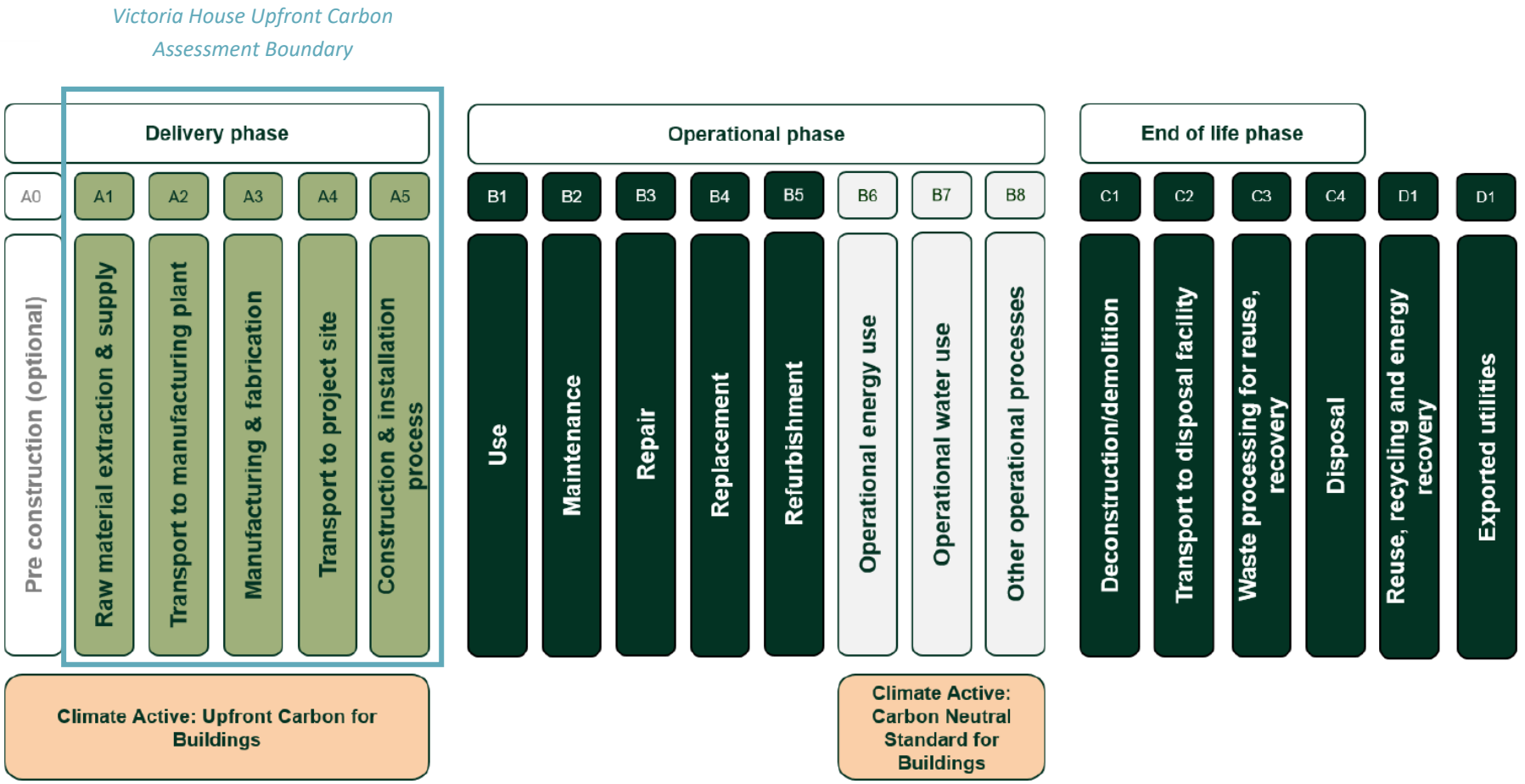

Figure 2 – System Boundary in accordance with EN 15978:2011- Guideline: Upfront Carbon for Buildings (Climate Active, 2022)

2 METHODS & LIFE CYCLE INVENTORY

2.1 Foreground data

Foreground data refers to data directly collected or measured data from the system being studied. In this case, the foreground data, supplied by WTP, can be found in document package as file named: '*231026 ESD Project Databook (VH) (With Markups by Perspektiv)'.*

2.2 Background Data

Background data, refers to data that is collected from external sources and not specific to the system being studied. This data is typically obtained from databases or previously published studies.

Database	Source
EPiC Database	Melbourne School of Design (2019)
AusLCI v36 Database	Australian Life Cycle Assessment Society (ALCAS)

2.3 Assumptions

Where gaps exist in the dataset, informed assumptions have been made and sourced as listed in the table below. Key gaps which have been modelled from assumptions and locally relevant guidelines include land clearing, manufacture, and supply of building services, construction, and demolition waste, as well as construction energy use.

Inventory Item	Reference Case Assumptions	As Constructed Case Assumption	Source/Reasoning
Gross Floor Area	Same as actual	20,543m2	231026 ESD Project Databook (VH
Construction energy - Gas	Same as actual design annual forecast	5000 GJ	Green Star Buildings Submission Guidelines V1.1 (Dec 2021) page 165, Other Carbon Emissions (Alternative Calculation Method): Where actual construction data is unavailable, emissions related to construction energy can be determined by equivalent of 5 years of forecast annual operational energy emissions. Refer 'FW_ Vic house energy' for annual forecast.
Construction energy – Grid Electricity		1,678,585 kWh	
Construction energy – Solar		498,685 kWh	
Reclaimed materials	0 tonnes	1,613 tonnes of brickwall, timber roof frame, concrete slab and metal roof deck	231026 ESD Project Databook (VH) and take-offs based on quantities provided in m2, m3 etc.
Demolition waste	1,819 tonnes	206 tonnes	Reference Case assumes all materials associated with old-hospital building are demolished. Waste fates modelled according to Green Star Upfront Carbon Emissions guidance [page 16, Table 2: Construction waste rates and fates for selected construction materials]
Construction waste	953 tonnes	921 tonnes	Waste rates and fates using Green Star Upfront Carbon Emissions Guidance [page 16, Table 2: Construction waste rates and fates for selected construction

Inventory Item	Reference Case Assumptions	As Constructed Case Assumption	Source/Reasoning
			materials] (Excl. building services)
Materials Transport	Same as actual	30km to site	Assumption used across the materials inventory based on average distances from local manufacturer or distributor to site.
Emission factor Electrical Services	Same as actual	0.22 tCO2e/$	IELab Scope 3 GHG Emissions Factor
Emission factor Hydraulic Services	Same as actual	0.22 tCO2e/$	IELab Scope 3 GHG Emissions Factor
Emission factor Mechanical Services	Same as actual	0.17 tCO2e/$	IELab Scope 3 GHG Emissions Factor
Electrical Services Package	Same as actual	$2.71 Million	Based on percentage cost breakdown, the impact for building services has been estimated based on '231102 Cost Breakdown'
Hydraulic Services Package	Same as actual	$1.97 Million	
Mechanical Services Package	Same as actual	$2.31 Million	
Land Clearing Emission factor	Same as actual	287 tCO2e/Ha	TAGG 2013 - Assuming Class 2 Vegetation and Vegetation Type F: Mallee and Acacia Woodland and Shrubland.

3 RESULTS

3.1 Upfront Carbon Impact

The following table displays a summary of the upfront carbon of the Reference and As Constructed cases, the overall carbon reduction, and an impact per functional unit of 'm2'.

3.1.1 Upfront Carbon Results Summary

Metric	Result
Reference Upfront Carbon Footprint (T CO2e)	9,947
As Constructed Upfront Carbon Footprint (T CO2e)	9,484
Percentage Carbon Reduction (%)	4.7%
GWP intensity of construction (kgCO2e/m2 GFA)	447.4

3.1.2 Results by Modules

The following upfront carbon results have been broken down into A1-A5 modules according to EN 15978:2011, as shown in the following table and chart.

	A1-A3	A4	A5
Module Description	Raw material extraction, transport, and manufacturing	Transport to site	Construction and installation
Reference / Base Case (T CO2e)	8,957	299	692
As Constructed / Actual Case (T CO2e)	8,561	293	630

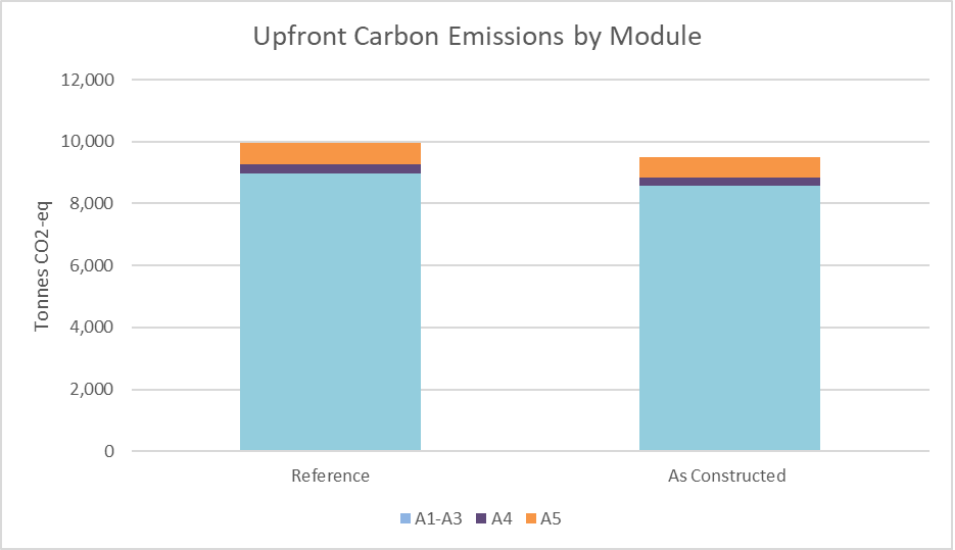

Figure 3 - Upfront Carbon Impact: Breakdown by Modules A1-A5

3.1.3 Top Contributors

The following table displays the top 5 impacts across modules A1-A5 and relevant reduction due to reclaiming of the construction materials.

Impact	Module	Quantity (TCO2e)	Reduction (%)
Insitu Concrete - Grade N32	A1-A3	2,041	6
Reinforcement Metal - Steel Bar	A1-A3	2,039	6.5
Construction - Energy Use - Site Electricity Consumption	A5	483	0
Roof and Wall Cladding - Brickwork 90mm Facebrick (Double skin)	A1-A3	619	9.1
Electrical Services Package	A1-A3	614	0

3.2 A1-A3 Construction Materials & A4 Transport

The results and savings from modules A1-A3 Construction Materials & A4 Transport have been broken down further in the following two charts. It should be noted that the categories of construction materials have been split according to the bill of quantity structure provided by WT Partners.

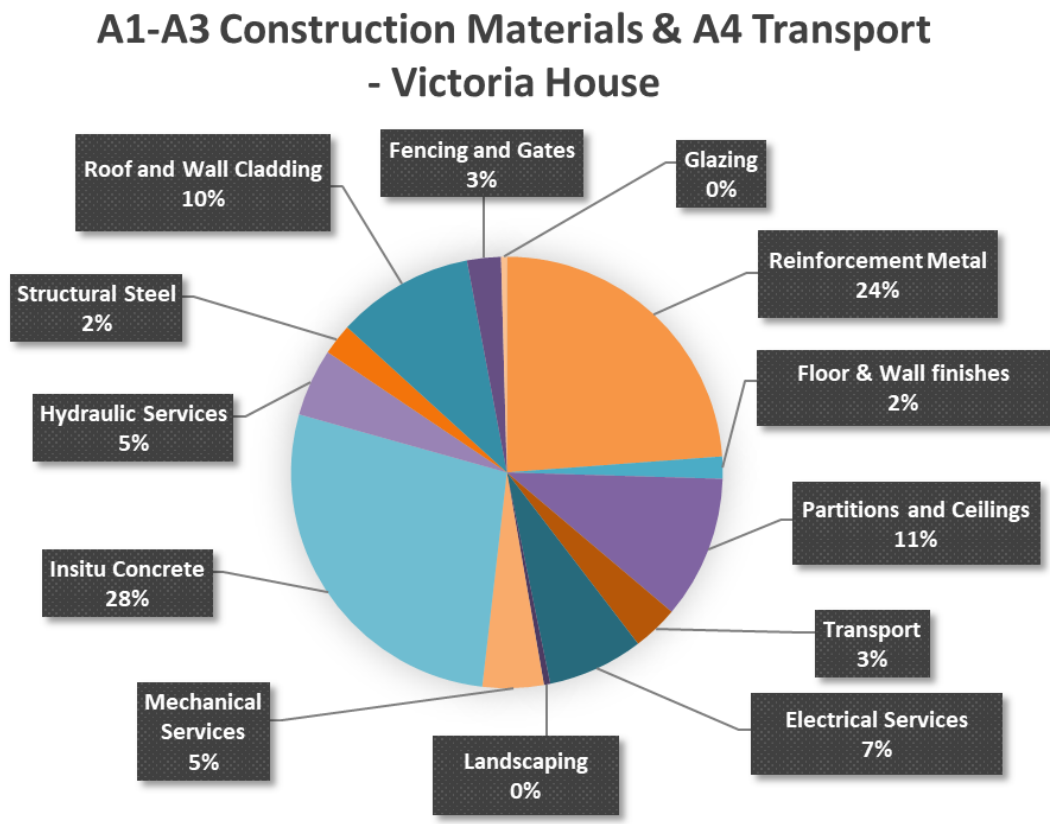

Figure 4 - A1-A4 Module Impacts: Construction Materials and Transport

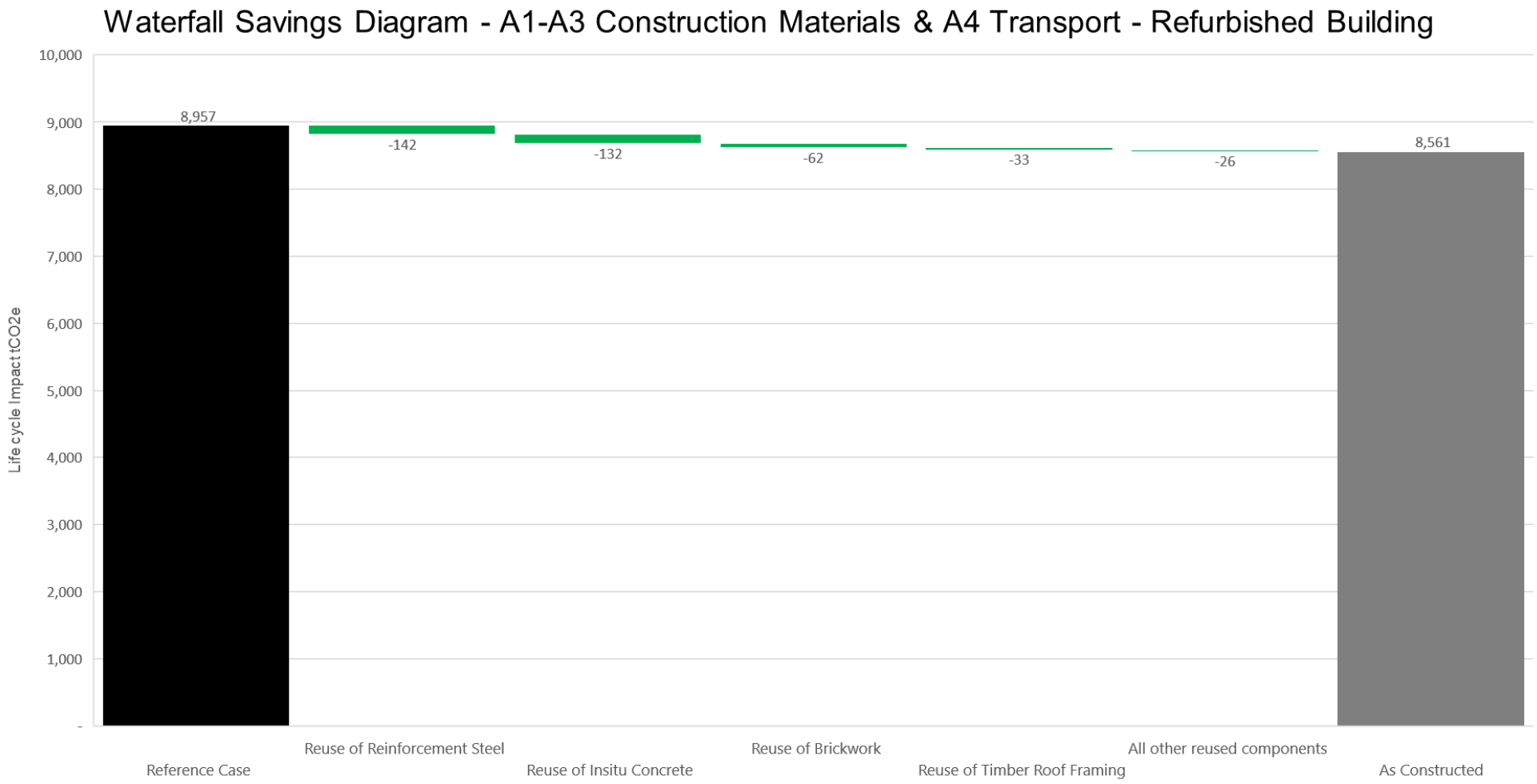

Figure 5- A1-A3 Construction materials & A4 Transport to site savings waterfall diagram

3.3 A5 Construction

The results and savings from modules A5 Construction and Installation have been broken down further in the following two charts.

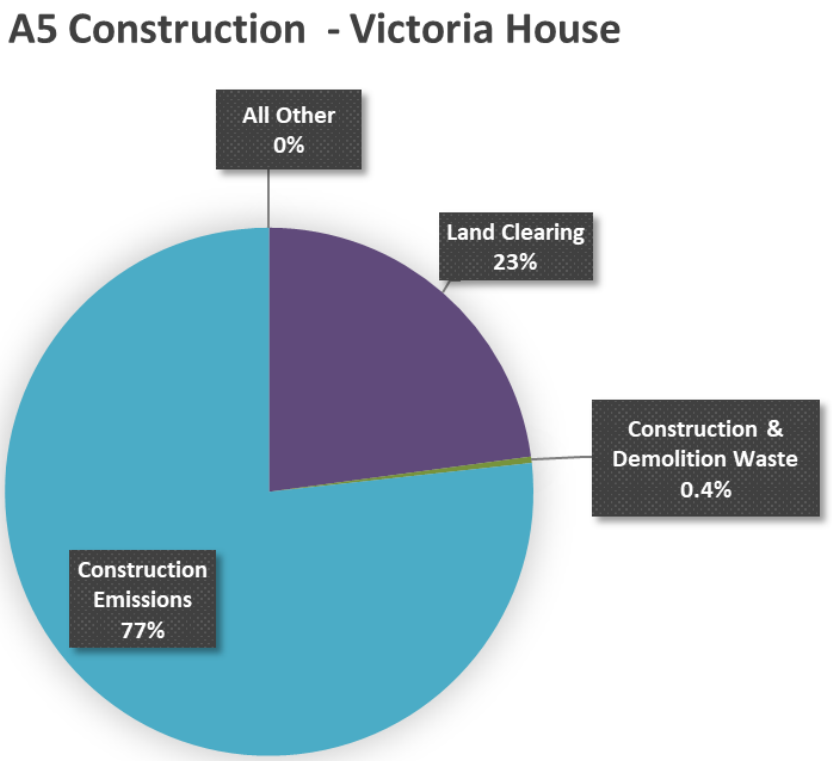

Figure 6 - A5 Module Impacts: Construction Energy Use

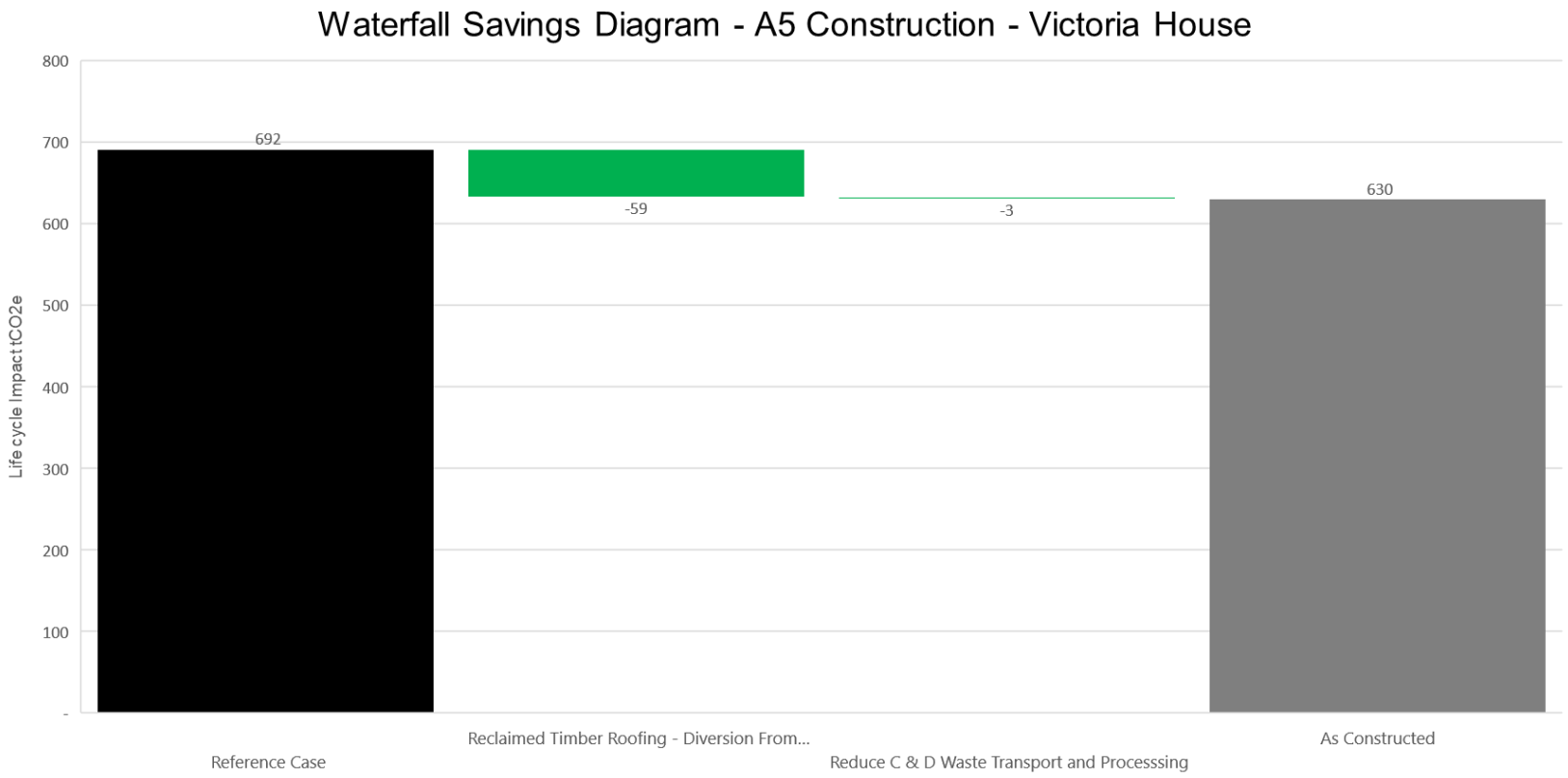

Figure 7 - A5 Construction Savings Waterfall diagram

3.4 Results for the Refurbished building

Looking at just the refurbished building shows just how much impact can be avoided by retaining existing building structures.

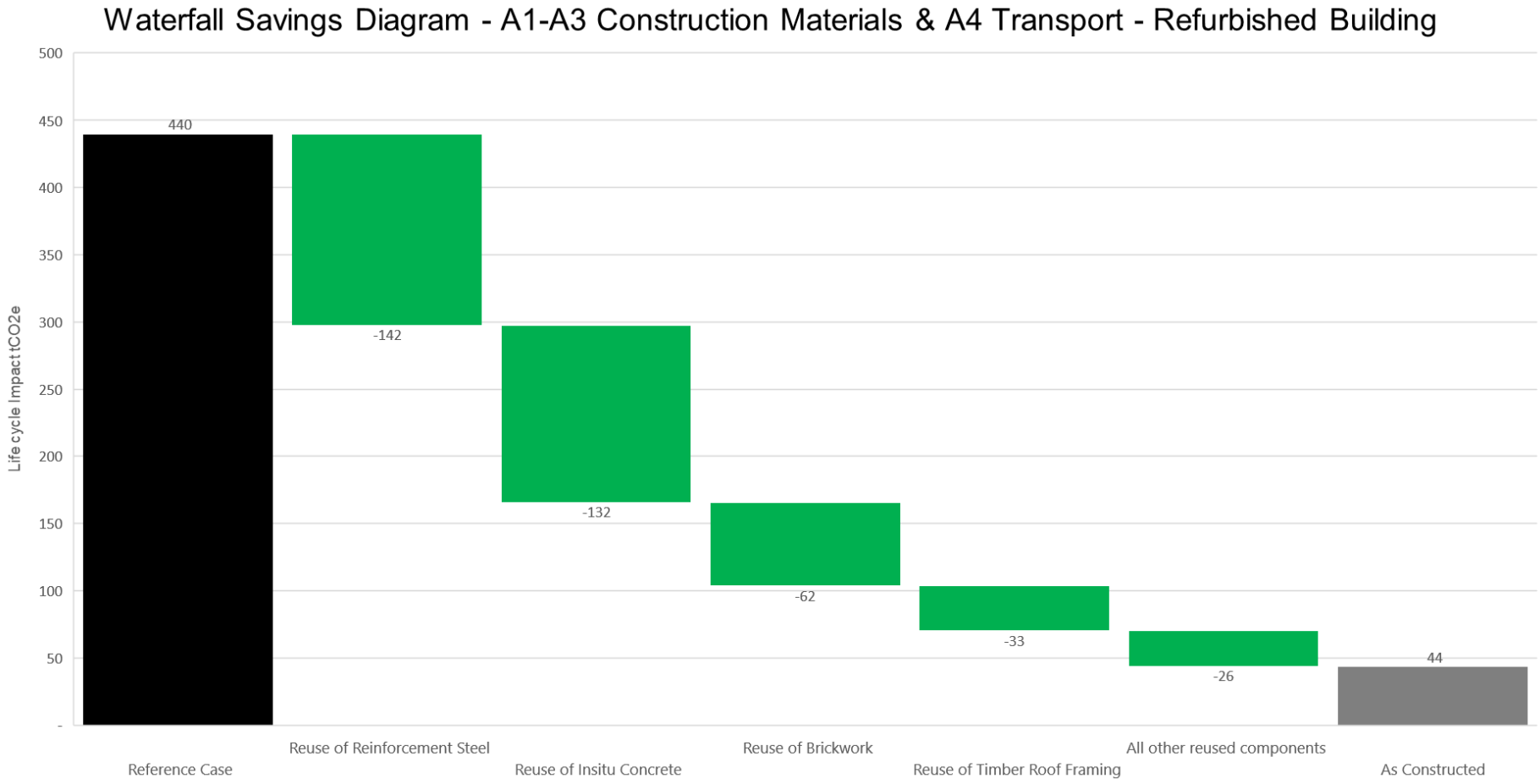

Figure 8 - Savings for the refurbished building

3.5 Impact per m2 GFA for buildings

The following table breaks down the results per m2 GFA to enable comparison between the whole project , new builds and the refurbished build.

3.5.1 Whole project

GFA	20,543 m2

Results in kgCO2e per m2 GFA

	Reference	As Constructed	Saving	Reduction %
A1-A3 Materials (Cradle-to-gate)	421	402	19	5%
A4 Transport to site	15	14	0	2%
A5 Construction & Installation	34	31	3	9%
Total A1-A5	**470**	**447**	**22**	**5%**

Table 2 - Results by module per m2 GFA for the whole project

3.5.2 Three new buildings

GFA	18,584 m2

Results in kgCO2e per m2 GFA

	Reference	As Constructed	Saving	Reduction %
A1-A3 Materials (Cradle-to-gate)	443	443	0	0%
A4 Transport to site	16	16	0	0%
A5 Construction & Installation	29	29	0	1%
Total A1-A5	**488**	**488**	**0**	**0%**

Table 3 - Results by module per m2 GFA for the new builds

3.5.3 Refurbished building

GFA	1,959 m2

Results in kgCO2e per m2 GFA

	Reference	As Constructed	Saving	Reduction %
A1-A3 Materials (Cradle-to-gate)	222	22	199	90%
A4 Transport to site	3	0	3	97%
A5 Construction & Installation	74	45	29	40%
Total A1-A5	**298**	**67**	**231**	**78%**

Table 4 - Results by module per m2 GFA for the refurbished building

4 INTERPRETATION

4.1 Results

The upfront carbon assessment results demonstrate that the embodied energy in manufacture of materials is the largest contributing factor with approximately 90% of the impact. Another 7% originates from construction energy, C&D waste and clearing. A small 3% is associated with the transport of construction materials to site.

Reclaiming materials in construction contributed to savings as shown in the table below. It should be noted that the materials reclaimed were only from parts of the old-hospital building, whereas the upfront carbon results also account for the three residential towers.

	Upfront carbon Impact Reduction
Reduction in As Constructed Case compared with Reference Case	**4.7%**

Table 5 - Comparisons of scenarios

These findings should be interpreted with the limitations discussed in the section below (4.2).

4.2 Limitations

This upfront carbon assessment was modelled using predominantly primary data of actual materials used in construction, as quantified by WT Partners. GHG emissions of various material types were calculated based on standard emissions intensities applicable across Australia. Remaining gaps of information were filled by means of conservative assumptions following current industry practice. For more accurate results, it is recommended that construction energy and waste be monitored and environmental product declarations be requested for key materials and products.

5 REFERENCES

5.1 Guidelines and Standards

- ISO 14040 Environmental management- Life cycle assessment- Principles and framework
- EN 15978-2011 Sustainability of construction works - Assessment of environmental performance of buildings
- GBCA (2022) GreenStar - Upfront Carbon Emissions calculation guide. Green Building Council of Australia
- Climate Active (2023) Guideline: Upfront Carbon For Buildings.
- Australian Life Cycle Inventory v36 (AusLCI) Database. Australia.
- EPiC Database (2019) Environmental Performance in Construction. Melbourne University School of Design.
- IELab (2018) Scope 3 Input-Output Greenhouse Gas Emission Factors.
- Infrastructure Sustainability Council (ISC). 2022. IS Materials Calculator v2.0..
- Transport Authorities Greenhouse Group (TAGG) (2013) Greenhouse Gas Assessment Workbook for Road Projects

5.2 Project Documentation and additional evidence

This report is to be read in conjunction with the relevant revision of the following documents:

- *Hesperia Vic House LCA*
- *VicHouse Upfront Carbon LCA Critical Review*

The following project-specific documents have been referred to as part of the upfront carbon model 'Hesperia Vic House LCA' and this report.

- *230725 ESD Project Databook (VH)*
- *231026 ESD Project Databook (VH) (With Markups by Perspektiv)*
- *231102 Cost Breakdown*
- *FW_ Vic house energy*

Additional third-party documents relating to products used on the project include:

- *Hebel-Tech-Man-Pt1-Products*
- *SPEEDPANEL®-78mm-Speedpanel-DATA-SHEET*

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