BUILDING PERFORMANCE

Embodied Carbon Assessment Report Summary

Building Name: Mā Wai Hakona / MBIE Hutt Hub

Building information

- **Typology** – Office internal fit-out
- **Area assessed** – 1459m² gross floor area (GFA)
- **Number of storeys** – Two
- **Seismic risk zone** – High
- **Year of completion** – 2023

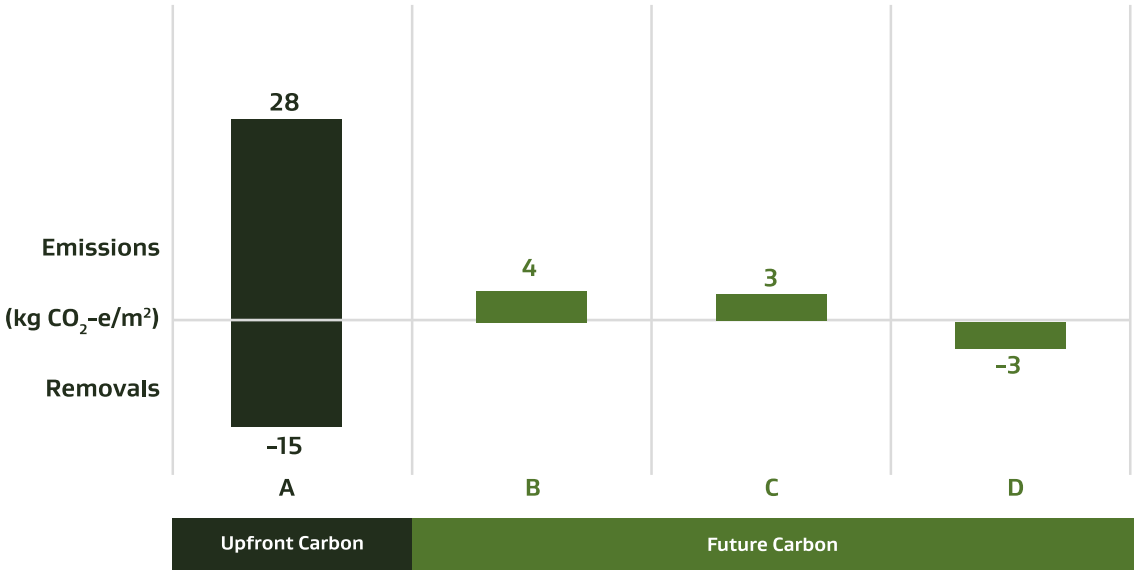
Assessment information

- **Date assessed** – May 2023
- **Purpose** – Carbon Neutral Government Programme (CNGP)
- **Design stage** – Detailed design
- **Assessor and role** – Warren & Mahoney, architect
- **Life cycle duration** – 15 years (fit-out elements only)
- **Material quantity data source** – Building information model (BIM)
- **Emission factor data source** – Prioritised according to the data hierarchy in the MBIE Technical Methodology
- **Tool used** – One Click LCA Life Cycle Carbon - Global tool
- **Building element scope** – Non-structural internal elements

Life Cycle Stages Assessed

A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	D
☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑	☑

Embodied Carbon by Life Cycle Stage



Assessment Summary

This assessment covers the integrated fit-out of MBIE's Mā Wai Hakona building at the Blue Mountains Campus in Upper Hutt. The embodied carbon of the existing building was assessed separately to the fit-out.

The assessment compares a traditional base build office fit-out, with an integrated fit-out. The integrated fit-out kept the existing floor tiles and suspended ceiling grid as they were, rather than replacing them. This design decision reduced waste and the amount of new materials used. When comparing this design to a traditional full internal fit-out option, an estimated forty tonnes of upfront embodied carbon emissions were avoided (page 17).

Assessment Highlights

This assessment closely follows the MBIE Technical Methodology and clearly outlines the building elements and life cycle stages that were in scope. As all life cycles stages were assessed, it is considered a whole-of-life embodied carbon assessment.

Embodied carbon is still a relatively new concept for the construction sector, and it can be difficult to quantify the climate impact in relatable terms. The results of this assessment have been converted into "emission equivalents", making the embodied carbon savings easy to compare to other activities (page 16).

Assessing a building's embodied carbon often enables significant emissions reductions in subsequent building projects, where the learnings from the first assessment can be applied. This assessment supports this by outlining the insights gained for future projects (page 18).

The assessment also clearly states assumptions made and grades the data used against the data quality hierarchy (page 24).

WARREN AND MAHONEY®

9733 MBIE Hutt Hub Workplace

May 2023 / Rev 5

Carbon Report

WARREN AND MAHONEY®

Prepared For

Ministry of Business, Innovation and Employment

Document Revision Status

Final Revision
Revision 5: 29/05/2023
Carbon Report

Document Control

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In 2007 Warren and Mahoney became New Zealand's first Toitū carbon zero certified architectural practice. Continuing with our high standards for environmental performance the services provided within this report have been completed in alignment with our net carbonzero certification. By procuring Warren and Mahoney's services you have made a positive impact on the environment.

Link below to further information on our carbonzero certification and alignment:
https://www.toitu.co.nz/our-members/members/warren-and-mahoney-limited

TOITŪ NET CARBON ZERO ISO 14064-1 ORGANISATION

Contents

Introduction

Purpose of this Report

This Carbon Report is provided for the benefit of the Ministry of Business, Innovation and Employment to understand the carbon emissions from their project. The Life Cycle Assessment is an audit of the interior design scope of works (Sub Divisional Hard Fit-out).

This report outlines Scope 3 Greenhouse Gas (GHG) emissions associated with MBIE Hutt Hub Workplace project from the purchase of products and services relating to the sourcing of project materials, construction, maintenance over a 15 year lifespan as well as end of life scenarios.

This report aligns with the reporting requirement and suggestions in the Carbon Neutral Government Programme: A guide to managing your green house gas emissions (V3.0 May 2023). The project GHG emissions are estimated using the MBIE Whole-of-life Embodied Carbon Assessment Technical Methodology.

Disclaimer

The accuracy of material data and material allowances is limited to the accuracy of data provided by the design team in the form of a digital model, drawing and specification.

The accuracy of material carbon intensity data is limited to data available in global materials databases accessible through One Click LCA Life Cycle Carbon-Global tool.

Where no specific material EPD exists, or the material has yet to be specified, material shadow databases will be utilised or similar available material data will be used.

The assessment herein is to understand the climate impact of the design. Further analysis, review and comprehensive reporting would need to be undertaken should the client decide to pursue Green Star credits or other certifications.

Sustainable Outcomes

This Carbon Report looks at the MBIE Hutt Hub Workplace project through a lens of greenhouse gas (GHG) emissions. Greenhouse gas emissions are a measure Global Warming Potential (GWP). Measuring GWP is one of the most effective ways we can take Climate Action, helping us to understand and mitigate our climate change impact.

However, Climate Action is only one lens and we should be mindful to consider the carbon assessment of this project alongside it's contributions to broader sustainable outcomes identified in the United Nations Sustainable Development Goals. Sustainable and regenerative outcomes look to build a holistically better future for individuals, their communities, the economy as well as the environment.

Figure 1: Sustainable Development Goals: https://sdgs.un.org/goals/goal13

Project Information

Project Details

Item	Detail
Project Name:	MBIE Hutt Hub Workplace
Project Number:	9733
Building Typology:	Office Interiors
Project Phase:	Completed Design
Physical address:	68 Ward Street, Wallaceville, Wellington
Earthquake Risk Zone:	Zone 3
GFA:	1459m²
Number of Floor Levels:	2

↑ Table 1: Project Details

Design Features

Item	Detail
Proposed Date of Completion:	July 2023
FSC % Specified:	100%
Certifications:	Interior Design scope of work is not targeting certification. Base Build scope of work targeting Green Star 5 rating.

↑ Table 2: Design Features

Methodology

Carbon Assessment Methodology

The methodology endeavours to align with MBIE Whole-of-life Embodied Carbon Assessment Technical Methodology for reporting stages and terminology. However, due to the nature of an interior carbon assessment, Service Life and Building Element Scope may vary. In this section, variances in scope have been documented in (Figure 1, p.7) and (Figure 2, p.8) for transparency.

Whole of Life Embodied Carbon Assessment Scope

Item	Detail
Design Life:	15 years
Life Cycle Stages:	Whole of Life (A1-D)
Operational Carbon:	Excluded from this assessment. Can be calculated on the provision of annual energy use data.

↑ Table 3: Whole of Life Embodied Carbon Assessment Scope

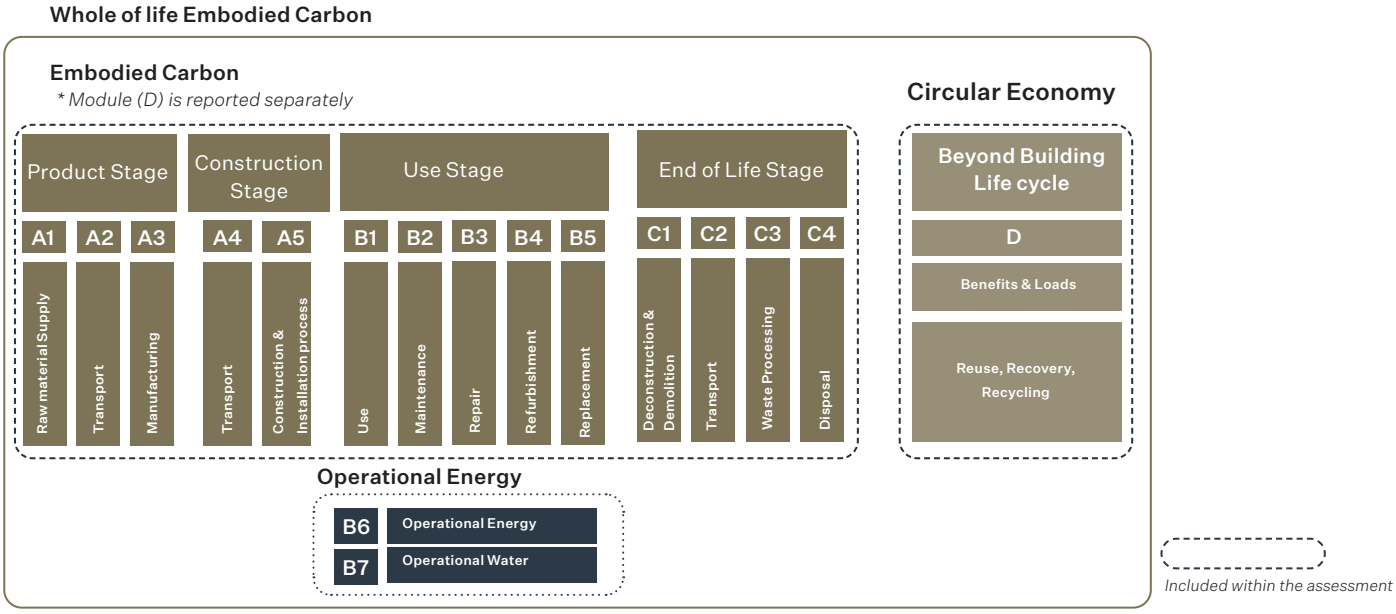


Figure 2: Life Cycle Assessment Scope Diagram aligned with EN15978

Life Cycle Scope

Building Element scope is 50 years and Interior Element scope is 15 years. This assessment considers the interior element scope of 15 years.

Site Waste Allowances and Operational Carbon

Allowances for site waste are in accordance with BRANZ Data Sheets.[1]
The Grid Factor for this assessment was 0.12 Kg CO^2/kWh.

Material Embodied Carbon Data

The level of data quality was aligned with MBIE's Material or Product Specification and Quantity Data.[2] At Level of Data Quality 5, exact product EN 15804 compliant EPD's were prioritised. Where this level of data was not available, BRANZ Co_2nstrcut Database was prioritised as a generic data source.

1. For more information refer to https://www.branz.co.nz/environment-zero-carbon-research/framework/data.

2. For more information refer to Section 4.4 (p.14) in MBIE Whole-of-Life Embodied Carbon Assessment Technical Methodology.

Carbon Assessment Methodology

Element Scope

The scope of this assessment is aligned with the interior scope of works for the Sub Divisional Hard Fit-out of Wallaceville. The assessment calculation of emissions is for a 15-year life span. Building elements included in the carbon assessment are specified in the table below.

Element Scope Table

Building System	Building Element	Included in Assessment	Excluded from Assessment
Ground Work			
Structure	• Stairs (V) • Floors	• Stairs (V)	
External Envelope			
Non-structural Internal Elements	• Non-load bearing walls	• Structure • Insulation	
	• Internal Doors & Windows	• Doors • Glazed Partitions	• Door Hardware
	• Wall Finishes	• Wall Finishes • Wall Trimmings • Acoustic Treatment	• Fixings
	• Floor Finishes	• Floor Finishes • Floor Trimmings • Underlay	• Fixings
	• Ceilings (V)	• Suspended Ceiling Systems (V) • Ceiling Finish (V) • Insulation (Bafflerock only) (V)	
	• Furniture		• Furniture
	• Joinery	• Benchtop • Door Fronts • Drawers • Shelves	• Joinery Hardware
	• Fixtures and Fittings		• Plumbing Fixtures and Fittings
Building Services	• HVAC equipment		• Hydraulic Services • Mechanical Services • Electrical Services • Light Fittings

Figure 3: Carbon Assessment Element Scope Table adapted from MBIE Whole of Life Embodied Carbon Assessment Technical Methodology

** (V) refers to building elements which are voluntary inclusions, as per MBIE Whole of Life Embodied Carbon Assessment Technical Methodology.*

Material Quantity Data

All material quantity data was extracted from the Revit Model provided by the design team at the time of the carbon assessment at data level 3.[3] Estimations of volumes is limited to the accuracy of the modelled elements.

3. For more information refer to Section 4.4 (p.14) in MBIE Whole-of-Life Embodied Carbon Assessment Technical Methodology.

Element Scope Diagrams

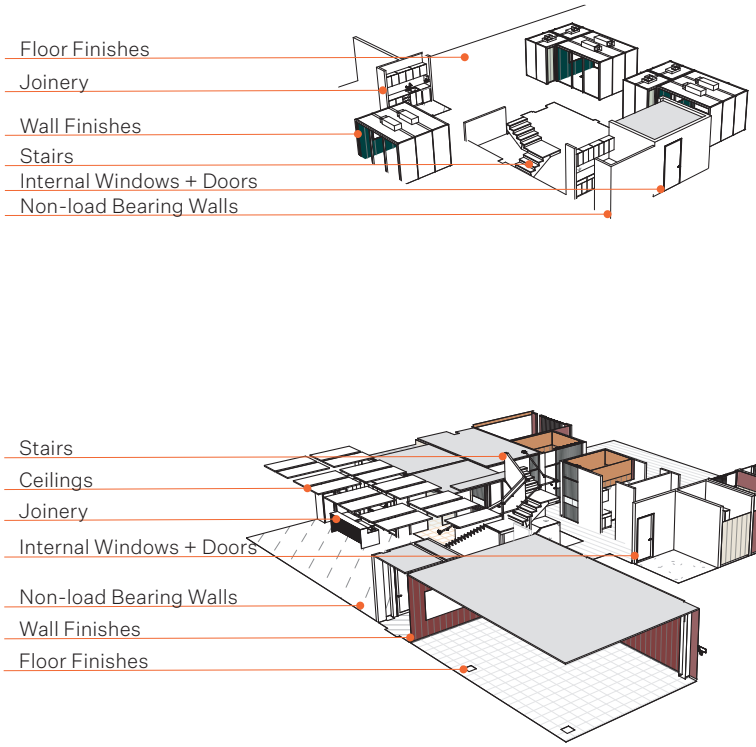


Figure 4: Included Scope Diagram

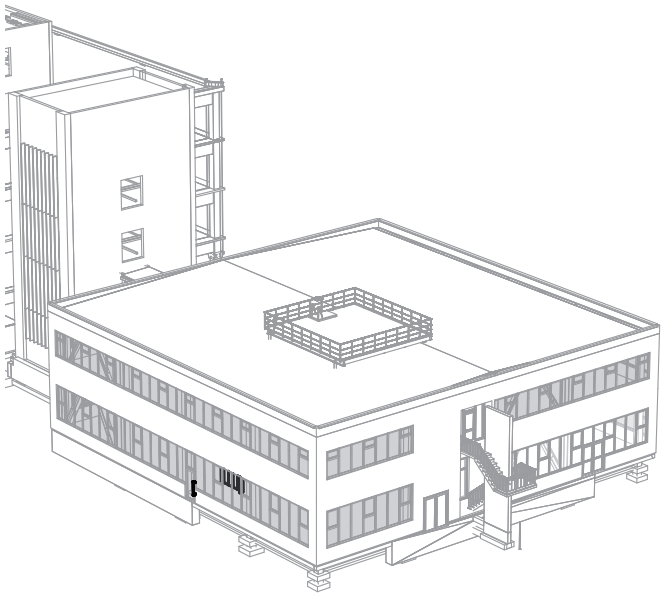


Figure 5: Excluded Scope Diagram

Carbon Assessment Software

Carbon Assessment Tool

The Global Warming Potential (GWP) is estimated using the Life Cycle Carbon Global Tool within One Click LCA. This tool provides an assessment of the project's GWP for a whole-of-life system boundary based on the International Standard ISO 14040 and the European Standard EN 15978. The product stage information for whole-of-life is outlined in Figure 1.

One Click LCA

The assessment has been carried out with One Click LCA software. The software holds 11 third-party certifications and complies with over 30 certifications and standards for Life Cycle Assessment and Life Cycle Costing, including all versions of LEED and BREEAM. The software includes curated and verified global and local databases.

The up-to-date list of integrated databases can be found here: https://www.oneclicklca.com/support/faq-and-guidance/documentation/database/

One Click LCA has been third-party verified by ITB for compliance with the following LCA standards: EN 15978, ISO 21931–1 and ISO 21929, and data requirements of ISO 14040 and EN 15804.

The full compliance documentation is available at https://www.oneclicklca.com/support/faq-and-guidance/documentation/compliancy-and-certifications/.

ITB is a certification organization and a Notified Body (EC registration nr. 1488) to the European Commission designated for construction product certification. Polish Accreditation Board assures the independence and impartiality of ITB services (Accreditation Certificates are: AB 023, AC 020, AC 072, AP 113). ITB activities are conducted in accordance with the requirements of the following assurance standards: ISO 9001, ISO/IEC 27001, ISO/IEC 17025, EN 45011, and ISO/IEC 17021. The tool supports CML characterization methodology as well as TRACI characterization methodology. All of the datasets in the tool comply with ISO 14040/14044 and, for the most part, also EN 15804 standard. Life Cycle Assessment Report 9/46.

Life Cycle Assessment for the Construction Industry

As businesses, governments and consumers develop environmental awareness and sensitivity, the focus of environmental impact reduction shifts to the industries responsible for the greatest impacts. Construction, maintenance and use of buildings and civil engineering works generate ca. 35 % of the carbon emissions globally. Furthermore, the industry is responsible for one-half of raw material extraction and a very significant amount of mass replacements and transfers. The sector is requested to reduce the impact on global warming and reduce raw material depletion, especially for non-renewable materials, via circular economy measures.

Life Cycle Assessment is a science-based methodology for measuring environmental performance. It is based on international standards and rigorously defined public methodologies for quantifying environmental impacts, expressed in the form of potential harm caused by activities to the biosphere, including atmosphere, soil and water bodies. Those impacts are expressed as "equivalent to" normalized units, for example, one kilogram of carbon dioxide in case of global warming potential.

Life Cycle Assessment considers the whole life cycle of the building, including manufacturing, transport, use and final disposal of the resources required for the delivery of the building functions for the entire period that the assessment covers.

The most common impact category covered by LCA is the global warming potential, also referred to as the carbon footprint. It quantifies the impact of greenhouse gases heating the planet. Other common impact categories are ozone depletion, acidification, eutrophication and smog formation.

LCA methodology also supports other indicators which describe the use of resources and energy. Those are more typically expressed as kilograms of material or mega joules in the case of energy.

One Click LCA Information provided from One Click LCA

Applicable International and European Standards

All building and civil engineering works Life Cycle Assessments delivered by One Click LCA platform comply with the following International Standards.
ISO 14040 Environmental management. Life cycle assessment. Principles and framework
ISO 14044 Environmental management -- Life cycle assessment -- Requirements and guidelines
ISO 21930 Sustainability in buildings and civil engineering works -- Core rules for environmental product declarations of construction products and services
One Click LCA platform tools used in the European context comply with the following European Standards:
EN 15978 Sustainability of construction works – Assessment of environmental performance of buildings – Calculation method
EN 15804+A1 Sustainability of construction works. Environmental product declarations. Core rules for the product category of construction products
Life Cycle Assessment Report 10/46

System Boundary

The International Standard ISO 21930 and European Standard EN 15804 set out a common life-cycle model for building and construction works. The life-cycle model includes modular definitions for the life-cycle stages, allowing each stage to be compared in isolation with other projects.

The product stage information (A1-A3) and Construction Stage (A4-A5) define the system boundary for a calculation under the certification.
Figure 4: Life Cycle Assessment Scope Diagram from IFLI Net Zero Carbon Certification

Methodology

Statement from IFLI Net Zero Carbon Handbook
“Tools used for life cycle assessment calculations must have the capability to complete at minimum a cradle-to-gate analysis in alignment with ISO 14044. In order to increase industry understanding of the LCA process and facilitate more accurate evaluations, tools that reveal their methodology and encourage data transparency.”
One Click LCA is listed as an approved tool to complete the calculation required for the certification standard. For consistency, the same tool will be used throughout the design process.
The impact category the LCA focuses on is Global Warming Potential (GWP).

One Click LCA Information provided from One Click LCA

Results

Carbon Assessment Results

MBIE Hutt Hub Workplace encouraged several objectives to manage the carbon impact of the design. The project scope prioritised using 100% FSC certified Timber and opted for low toxic healthy materials and finishes. This prioritised the use of Low Volatile Organic Compound (VOC) or VOC-free paints and finishes and the specification of durable materials. Additionally, giving preference to environmentally certified materials (i.e. Environmental Choice NZ or Green Tag Level A) where possible also impacted the results.

MBIE Hutt Hub Fit-out Total Results

42
t CO_2e-
Upfront Embodied Carbon

52
t CO_2e-
Whole-of-life Embodied Carbon

-22
t CO_2e-
Biogenic Carbon

Results per m²

28
$kgCO_2e$-/m²
Upfront Embodied Carbon

36
$kgCO_2e$-/m²
Whole-of-life Embodied Carbon

-15
$kgCO_2e$-/m²
Biogenic Carbon

Results Over Life Cycle Stages

Material Production			Construction		Use Stage (15 years)					End of Life				Beyond
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4	D
41,536 $kgCO_2e$					6,464 $kgCO_2e$					4,689$kgCO_2e$				-5,116 $kgCO_2e$

22,414 $kgCO_2e$
Biogenic Carbon

Emission Equivalents for Whole of Life Emissions

217 NZ Road trips

between Cape Reinga and Bluff, in an average petrol car* would produce the same amount of greenhouse emissions as the project emits over its 15 year lifespan

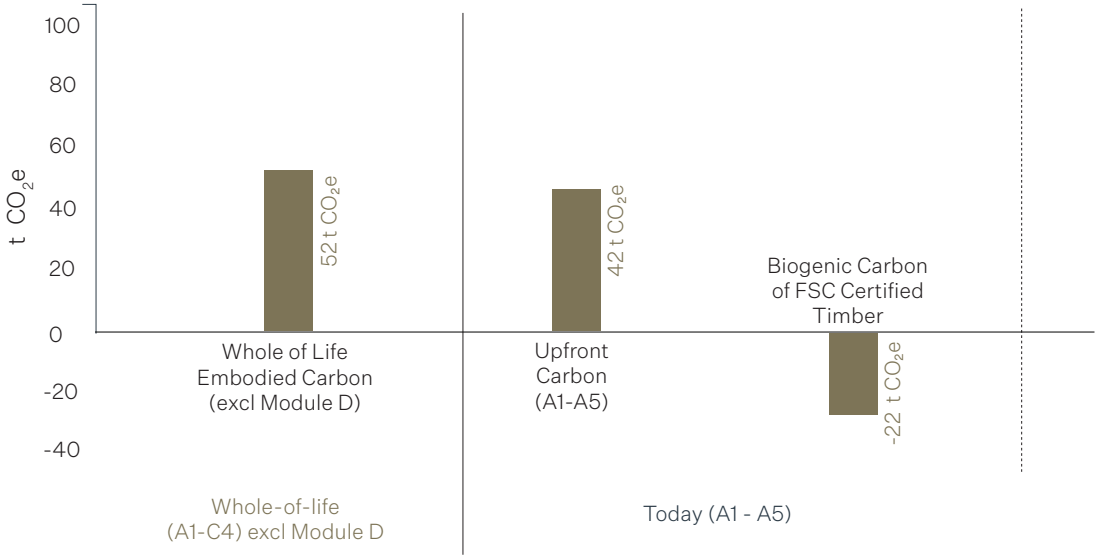
867 Tree Seedlings

would need to be grown for 10 years to absorb the amount of greenhouse emissions** from the atmosphere that will be emitted from this project over its 15 year lifespan.

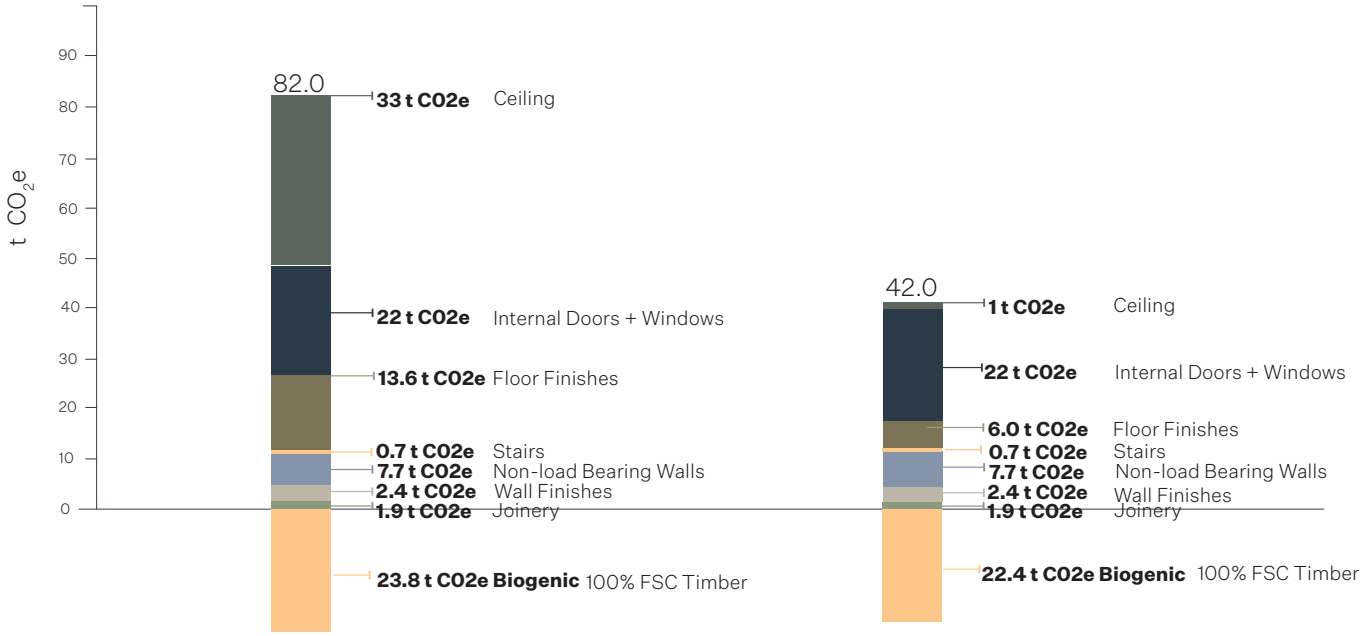
* Total whole-of-life embodied carbon for an average petrol car is 0.171 $kgCO_2$/km. Distance from Cape Reinga and Bluff = 1,403km
Source: https://www.beehive.govt.nz/sites/default/files/2021-01/Clean%20Car%20Import%20Standard%20Explainer_0.pdf
** Source: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Carbon Assessment Graphs

Balance of Totals (t CO_2e) 15 years



Upfront Embodied Carbon Emissions Comparison



Base Build Tenancy Full Fit-out

Baseline

* Includes full ceiling and carpet basebuild provisions.

MBIE Hutt Hub Fit-out

(Scope of Works)

Insights for Future Projects

MBIE Hutt Hub Workplace has a relatively low embodied carbon result per m² which can be credited to an Integrated fit-out as well as the use of timber in wall framing.

Due to the nature of an interior fit-out at the time of assessment small items such as handles, equipment or furniture are not possible to include. It can safely be assumed that if these were to be included this would increase the overall emissions of the project.

Key Design Insights:

1. Integrated Fit-out
The integrated fit-out meant a smaller amount of waste was sent to landfill than might have been if a more traditional leasing arrangement had occurred. Often 'base build' carpet and ceiling tiles are provided and then removed, and replaced with tenancy selections almost immediately which is a very wasteful process. As this assessment is aligned with the fit-out Scope of Works the base-build materials are included in the Baseline but not in the results.

2. Ceilings
In this project, the Base Build included a suspended ceiling grid so this was included in the Baseline Assessment but not the MBIE Hutt Hub Workplace Fit-out assessment. Suspended ceilings are very high in embodied due to the amount of aluminium in the system which is a high embodied carbon material. Removing the suspended ceiling system was not explored for this project.

Future projects could choose to reduce the extent or not include a suspended ceiling to reduce embodied carbon but the carbon benefits would need to be assessed against any increase in cost for exposing the services.

3. Timber Framed Walls
The decision to use timber framed walls avoided **1.6 t CO_2e** compare to a steel stud wall framing system. This is equivalent to 31766 km driven by an average gasoline-powered passenger vehicle.

31766 km avoided

4. Carpet
Carpets are usually a large proportion of fit-out emissions and contribute significantly to whole-of-life emissions because they are assumed to be replaced several times over a 50-60year lifespan of the building. There a several ways to reduce emissions associated with flooring such as selecting a carpet with a high recycled content and cradle to cradle take back schemes. Design teams can also consider using more durable surface that need less replacement.

5. Biogenic Carbon Stored in Timber Stair
The timber stair stores **0.483 t CO_2e** of biogenic carbon in the timber from sequestration of carbon dioxide in it's growth years. This project has assumed the used is timber is 100% FSC. If a project was going for certification this must be proven with documentation. The carbon stored in the stairs is equivalent to driving 1992 km in an average gasoline-powered passenger vehicle.

1992 km 'stored'

6. Glazed Partitions and Doors
When we only consider the fit-out scope of works, the building elements that contributed the highest proportion of carbon emissions in this project were the glazed partition suites (which is categorised under internal doors and windows), which came to a total of 53% of upfront embodied carbon. The glazed partitions contain aluminium mullions, a carbon-intensive element. Future projects could consider timber mullions or reducing the amount of partitions used to achieve a lower carbon result.

Future Projects
There are three man factors which contribute to the embodied carbon of a project - the carbon intensity of materials, low much material there is per area and how much area. Therefore some design strategies to consider for future projects might be:

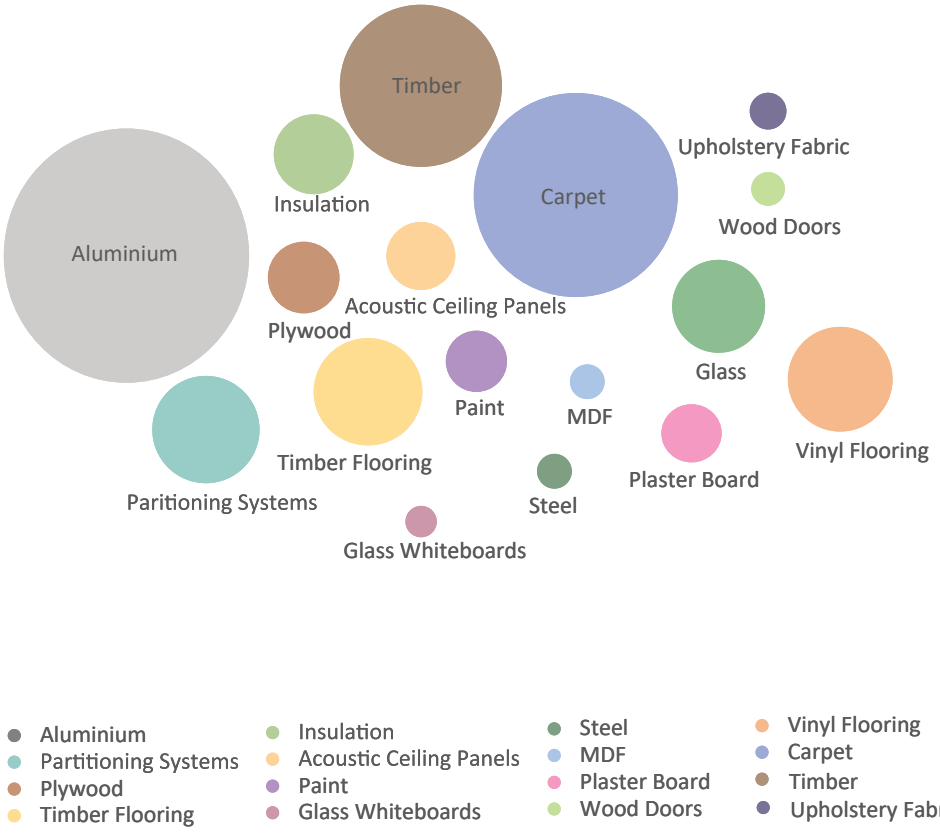
- Give preference to low carbon products, materials and systems. Low carbon materials often include bio-based materials like flax, wood fibre or wool, recycled content or are reclaimed materials or have a circular life cycle. Durable materials that need no maintenance will have less embodied carbon over Whole of life. Including more sustainably certified (eg FSC) materials that store biogenic carbon will increase biogenic carbon stored in the project.
- Taking a minimalist or dematerialised approach to design can reduce embodied carbon. This is where only materials that are needed are included and the design reduces the amount of material build-ups or superfluous material.
- Understanding space utilisation can allow a smaller space to provide the same functionality. Consider using technology to optimise the amount of office space required.

* Km driven by an average gasoline - powered passenger vehicle: https://www.epa.gov/energy/greenhouse-gas-equivalencies-calculator

Material Contributions

Contributing materials are shown in the bubble diagram below. The size of the bubble reflects the total life cycle impact of each material, recognising the quantity compared to other materials in the project.

Total Whole of Life Cycle Impact by Material



Appendix

Contents

Glossary

Term	Definition
Architectural Scope Model	Revit model of the architectural and structural elements of the project produced by the project architect team.
Biogenic Carbon	Biogenic carbon dioxide (CO2) is carbon dioxide released as a result of the combustion or decomposition of organic material that is, biomass and its derivatives.
Carbon-dioxide equivalent (or CO2e)	Carbon dioxide equivalent is measured in kg of carbon equivalent. It is related to the potential climate change impact.
Carbon offset	An offset is where an avoidance, reduction, or removal of a carbon emission is used to compensate for or neutralise a CO2 emission that occurs elsewhere (World Green Building Council, 2021).
Characterisation Method	Both CML and TRACI Data are examples of the Characterisation Method applied to the One Click LCA software.
CML Data	Is a method that is used to characterise and assess data around the world.
Data	Refers to the quantitative data of applied construction materials and their volume from Revit Models.
Data Rows	Quantitative data of applied construction materials and their volume from Revit Models formatted into rows.
Environmental Product Declarations (EPDs)	A third-party verified report of Life Cycle Assessment (LCA) results.
IL	Refers to the required level of seismic performance for a building. This increases with each level of importance ranging from level 1 (lowest) to 5 (highest). Clause A3 of the Building Code defines the significance of a building by its importance level (IL), which is related to the consequences of failure.
Life Cycle Assessment (LCA)	Is a standardized method of assessing the potential environmental impacts associated with all the stages of a product's or building's life, from raw material extraction, processing, and manufacture, through distribution, use, repair, and maintenance, all the way through to end-of-life disposal or recycling. For buildings, this is also referred to as Whole-Building Life Cycle Assessment.
Localisation Method	Is a method that allows foreign materials to have their emissions adjusted (localised) to simulate local manufacturing conditions.
Localisation Method	Is data that has been identified and paired to available EPDs for comparative materials within One Click LCA.

Term	Definition
TRACI Data	Is a method that is used to characterise and assess data in North America.
Material Mapping	Is data that has been identified and paired to available EPDs for comparative materials within One Click LCA.
One Click LCA	One Click LCA is the #1 easy and automated life cycle assessment software that helps you calculate and reduce the environmental impacts of your building & infra projects, products, and portfolio. (One Click LCA, 2022) .
Revit	Autodesk Revit is a building information modelling software for architects, landscape architects, structural engineers, mechanical, electrical, and plumbing engineers, designers, and contractors.
Structural Scope Model	Revit model of the structural elements of the project produced by the structural engineer.
Upfront (embodied) carbon	Total carbon emissions produced in the production and construction process stages of a building life cycle, including emissions from raw material supply, manufacturing, transportation, and construction or installation of a building (World Green Building Council, 2021).

Mapping and Assumptions

Material	Location / component in Project	Mapping	Database	Data Quality (Based on section 4.4, p.14 in MBIE Whole-of-Life Embodied Carbon Assessment Technical Methodology)	Assumption
Internal Structure					
Internal Wall Framing		Internal Wall - Timber Frame (25%) + Insulation (75%) BRANZ, Developed as a volume to be applied to a range of thickness	Private Database	3	25% Timber Framing
Interior Finishes					
Tuffed Carpet Tiles	Flooring	Tufted carpet tiles, 0.745 kg/m^2, pile material of polyamide (PA) 6, with textile backing (New Zealand carpet manufacturers & Carpet Institute of Australia Limited (CIAL))		4	
Aluminum Mullions	Aluminum Framed Glazing partitions	Interior Aluminum Frame	Private Construction	2	Allowance of 1.7kg from a similar profile by company T&R Interior Systems
Glass	Aluminum Framed Glazing partitions and doors	Float glass, single pane, generic, 3-12 mm (0.12-0.47 in), 10 kg/m^2 (2.05 lbs/ft^2) (for 4 mm/0.16 in), 2500 kg/m^3 (156 lbs/ft^3)		3	

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