Life cycle assessment

Waikoukou case study

22 Boulcott St, Wellington

The refurbishment of 22 Boulcott Street, Wellington, was completed in 2017. During the refurbishment, much of the original building's structure and foundations were retained. New reinforced concrete shear walls, structural steel framing and a curtain wall façade system were added. Originally two separate structures, the refurbishment saw the connection of two buildings and the addition of a further 3 storeys.

The building is home to Transpower's Wellington offices and critical facilities.

The life cycle assessment included consideration of materials used in the structure, walls, floors and roof. It excluded materials in the building services and fit-out.

Building LCA tool:	LCAQuick v3.3
Available at:	www.branz.co.nz/buildinglca
Assessment year:	2018

Project team

Client and tenant:
Transpower New Zealand

Developer:
McKee Fehl Constructors Ltd

Assessor/BIM modelling:
Sanjeev Ganda

Energy modelling:
Jason Quinn (COR Associates)

Building information

Number of storeys:	6
Building height:	49.4 m
Gross floor area:	11,220 m²
Net lettable area:	8,336 m²
Other use floor area:	401 m²
Internal car parking:	2,333 m²
Assessment service life:	60 years
Energy use intensity: (whole building, simulated)	80 kWh/m² GFA/year

Building life cycle results (rounded)

Environmental indicator	Per NLA/year	Absolute (60 years)	Benefits/loads beyond building life cycle		Unit
			Per NLA/year	Absolute (60 years)	
Climate change	22.48	11,245,627	-1.03	-513,451	kg CO_2eq
Ozone depletion	0.00000043	0.22	-0.00000001	-0.005	kg CFC 11eq
Soil and water acidification	0.11	54,695	-0.004	-1,722	kg SO_2eq
Eutrophication	0.037	18,485	-0.0004	-188	kg PO_4^{3-}eq
Photo-oxidant formation	0.007	3,634	-0.0006	-297.5	kg C_2H_2eq
Abiotic resource depletion (non-fossil fuels)	0.00007	32.55	0.000007	3.41	kg Sb eq
Abiotic resource depletion (fossil fuels)	138.1	69,071,645	-10.19	-5,097,994	MJ, NCV
Total primary energy	409.3	204,729,626	-11.7	-5,858,175	MJ, NCV
Total primary energy (non-renewable)	140.4	70,243,263	-10.16	-5,080,832	MJ, NCV
Total primary energy (renewable)	268.9	134,486,363	-1.55	-777,343	MJ, NCV

Presented results represent the sum of all life cycle stages including both base build and tenant energy use. Reported separately are the potential benefits or loads beyond the building's life cycle. For example, this may be due to waste materials from construction that are recycled. This can provide secondary materials that substitute for new (primary) materials. A benefit is shown as a negative number, and a load is shown as a positive number.

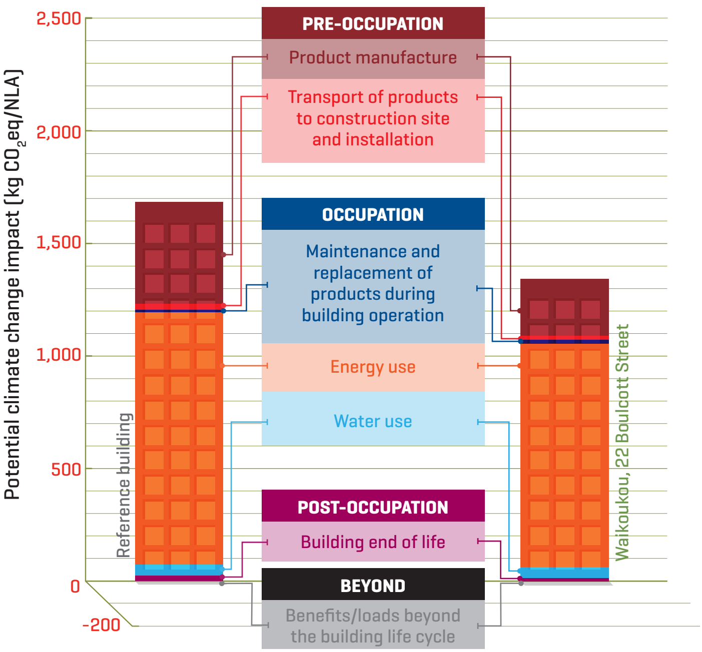
Comparison with a reference building

About the reference building

A reference building provides a comparator for the designed building. In this case, it is a specific office building located in Auckland but with energy use simulated as if located in the Wellington climate. Characteristics of the selected reference building are:

- GFA of 7,789 m² and NLA of 5,088 m²
- office space (65%) and internal car parking (24%)
- concrete/steel rigid frame construction.

The reference office building is modelled based on the materials specified in the consent documentation and simulated (rather than actual) energy use.



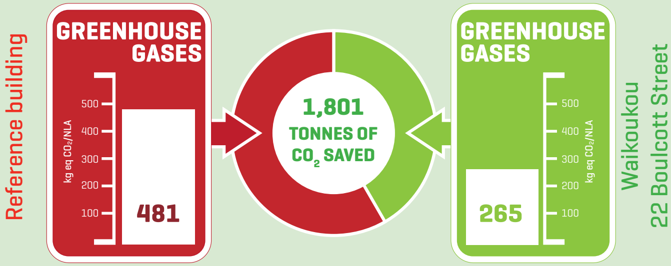
Pre-occupation phase

Manufacture of materials, transport to the construction site and construction of a new-build office can significantly contribute to lifecycle greenhouse gas emissions. Furthermore, these emissions can occur within a short period of time (1–2 years) prior to the building's occupation.

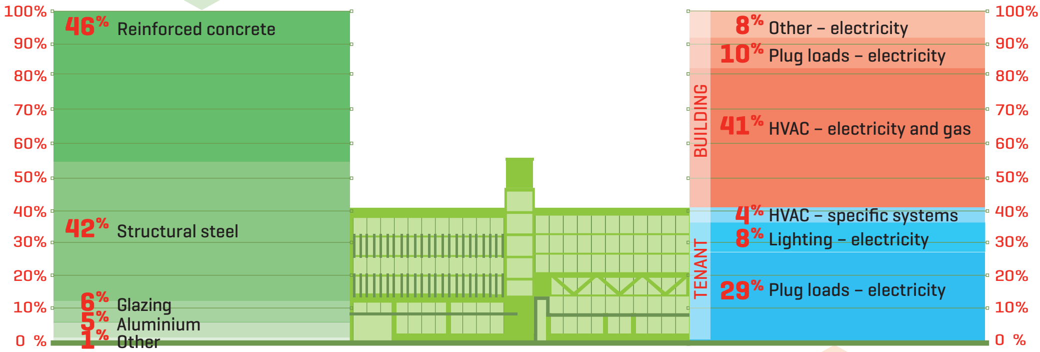
The choice to refurbish the existing building has meant that much of the existing concrete and steel structures have been retained. New structural elements have been added, such as reinforced concrete shear walls and a steel frame. A decision to demolish and rebuild on the site would have required construction of an entirely new structure with associated greenhouse gas emissions as well as emissions from demolition.

Retained elements from the original building are not included in the assessment. Through reuse, the greenhouse gas emissions due to materials in the structure and enclosure are about 43%* of what they could have been had the decision been taken to build from new.

The main contributors to the embodied greenhouse gas impacts of the building are reinforced concrete, structural steel and glazing.



* Based on comparison with the reference building. Excludes benefits/loads beyond the building life cycle.



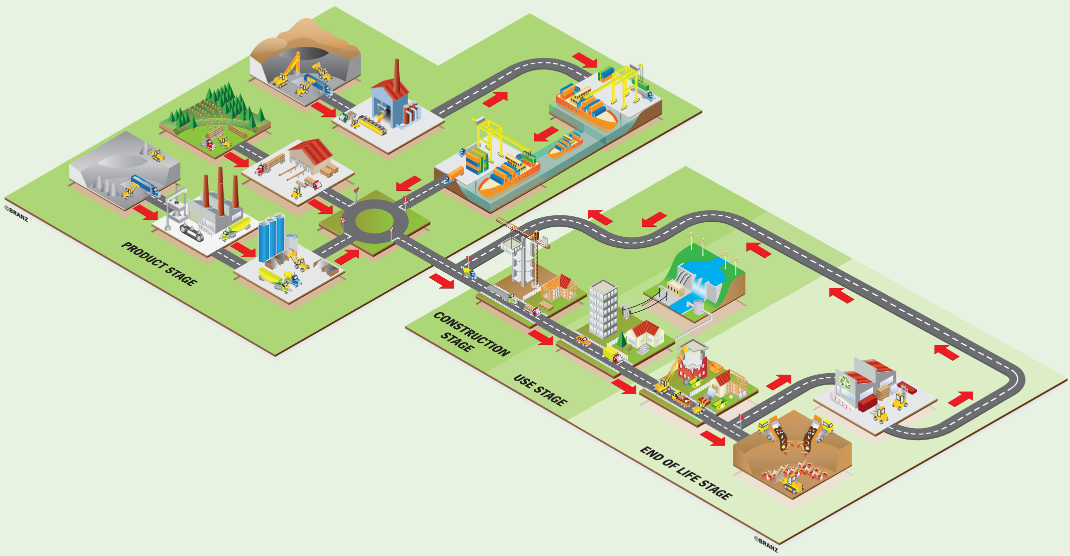
Occupation phase

This phase is 79% of the potential climate change impact calculated for Waikoukou (excluding benefits/loads beyond the building life cycle), making it the largest single contributor over the life cycle. However, this is spread over a 60-year period.

Energy is the most significant contributor, split between uses summarised in the diagram above (based on kWh used). The existing HVAC system was removed and replaced with three air-cooled chillers providing chilled water and three gas condensing boilers providing hot water to EC fan coils throughout the conditioned space. A heat-recovery system allows pre-heating of outdoor air brought into the building, with stale air removed from the building with exhaust fans.

The building features a building management system, LED lighting and ambient light controls.

What is building life cycle assessment (LCA)?



Building LCA is a tool for quantifying the potential environmental impacts of a building through its use of resources and energy across the life cycle. The assessment is systematic and requires making an inventory of the activities that are collectively needed to produce, operate and ultimately dispose of the building being investigated.

Application of building LCA early in design helps the design team understand the potential environmental impacts that may arise because of choices being made, such as building orientation and form, window-wall ratio and where windows are located, type of structure and thermal performance of the building envelope. This information can be used to consider, test and evaluate alternatives and quantitatively track the environmental performance of the design.

The approach can also be used by clients to set quantified environmental targets in a design brief against which the design team can demonstrate the design's performance.

The indicators in this case study are in accordance with the building sustainability standard EN 15978:2001. For further information about these indicators, please refer to BRANZ Study Report SR293, available for download at www.branz.co.nz.

Acronyms

GFA	Gross floor area
kg eq	Kilogram equivalent
LCA	Life cycle assessment
MJ	Megajoules
NCV	Net calorific value
NLA	Net lettable area

Contact

Dave Dowdell
Principal Scientist Sustainability
Ph: 04 237 1174
Email: david.dowdell@branz.co.nz

Jarred Butler
Associate Building Environmental Scientist
Ph: 04 237 1176
Email: jarred.butler@branz.co.nz

www.branz.co.nz/buildinglca