BRANZ

Life cycle assessment

Mason Brothers case study

139 Packenham Street West, Auckland

Originally a 1920s warehouse used by the Mason Brothers Engineering company, the 2016 redevelopment has delivered a stunning character building ready for its second lifetime. The 5,700m^2 three-level workplace is a key part of Auckland's Wynyard Quarter Innovation Precinct, established to foster collaboration, innovation and economic development. The developer and long-term owner Precinct Properties aspired to a high-quality development that supported Wynyard Quarter's Sustainability Standards and ensured long-term operational efficiency, durability, flexibility and enhanced amenity for its tenants. Mott MacDonald was the building services, façade and sustainability consultant tasked along with architects Warren & Mahoney and the wider consultant team to deliver these goals.

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

Project team

Tenant:
Various

Client and developer:
Precinct Properties

Precinct

LCAQuick assessment:
Mott MacDonald,
Chris Edwards

Energy modelling:
Mott MacDonald
Anthony Calderone

MOTT MACDONALD

Building information

Number of storeys:	3
Building height:	13 m
Gross floor area:	5,700 m^2
Net lettable area:	4,700 m^2
Assessment service life:	60 years
Energy use intensity (whole building, simulated):	92 kWh/m^2 GFA/year
Energy use intensity (whole building, measured):	95 kWh/m^2 GFA/year

Version 1.1

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	26.5	7,118,448	-0.90	-241,380	kg CO_2eq
Ozone depletion	0.0000006	0.16	-0.000000005	-0.0014	kg CFC 11eq
Soil and water acidification	0.13	35,282	-0.0027	-733.1	kg SO_2eq
Eutrophication	0.066	17,637	-0.0003	-80.5	kg PO_4^{3-}eq
Photo-oxidant formation	0.010	2,783	-0.0005	-136.8	kg C_2H_2eq
Abiotic resource depletion (non-fossil fuels)	0.00007	18.8	-0.0005	-138.6	kg Sb eq
Abiotic resource depletion (fossil fuels)	202.4	54,291,726	-9.28	-2,489,790	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.

Building achievements

Following 2 full years of operation, the building has exceeded the original project ambitions. Through Mott MacDonald's integrated sustainability and high-performance design approach, the building has achieved:

- an estimated 3,200 tonne CO_2eq reduction relative to a reference building across the building life cycle
- a 6 star Green Star As Built rating representing world leadership in sustainable design
- a 5.5 star NABERSNZ base building rating, representing a 60% energy reduction compared to standard offices
- an independently verified 50% reduction in global climate change impact in construction and operation
- enhanced occupant amenity and energy efficiency through detailed performance simulations
- no capital premium above the 5 star Green Star and 4.5 NABERSNZ brief requirement (4% premium over business as usual construction)
- 8% improvement in occupant productivity based on the BUS methodology
- 20-25% reduction in absenteeism costs (data from all building tenants).

Other project awards

- CIBSE: 2020 International Project of the Year
- 6 Green Star Design and As Built (equivalent to LEED Platinium or BREEAM Outstanding)
- 5.5 star NABERSNZ Energy Rating
- New Zealand Property Council Sustainable Building of the Year 2019 (best in category)
- New Zealand Property Council Commercial Building of the Year 2017 (merit)
- New Zealand Property Council Heritage/Adaptive Re-use Building of the Year 2017 (merit)
- Association of Consulting Engineers New Zealand (ACENZ) Innovation Award Winner (silver)

What did the refurbishment involve?

The refurbishment comprised adding an additional level and increasing the gross floor area by over 3,000 m^2 and the net lettable area by over 1,400 m^2.

The existing building structure was retained. Mott MacDonald additionally used LCAQuick to estimate the associated greenhouse gas saving. This produced a conservative figure of at least 500 tonnes CO_2eq saved. More structural elements were added to strengthen the building in accordance with modern building standards, such as steel columns and beams, new concrete floor slabs and precast concrete fire stairs and some precast concrete beams. New concrete footings and piles were added to the building foundations.

The building façade was largely retained with a new curtain wall façade and shopfront window glazing added to complement the retained brick and increase the amount of natural light within the building.

A metal deck roof was installed to replace the existing roof, which contained asbestos.

The installed HVAC consisted of chilled and heating water fan coil units with central air-handling units for outside air supply. Reversible heat pumps were incorporated as the heating and cooling source.

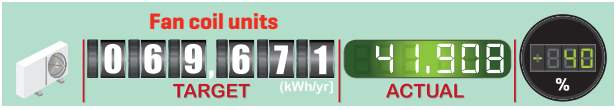
A hot water heat pump with electric boost provides the heating source for a central hot water system with hot water return.

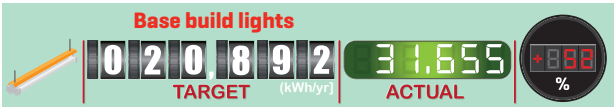
Designed versus actual performance

During design, the energy simulation model was split into different categories. Submetering was installed to track actual performance against design estimates.

Overall, measured energy consumption for the whole building was ~3% above estimated energy consumption due to tenant consumption being higher than anticipated. Measured base building energy use was 10% less than predicted due to building tuning once occupied.

Actual outcomes tend to differ from estimates due to variations such as occupancy, building operation and maintenance and weather conditions amongst others. Building tuning, monitoring and targeting is an important additional step post-completion.





Possible reasons for difference in actual performance compared to energy simulation:

- Single heating/cooling set point of 22.5°C used rather than heating 21.5°C/cooling 22.5°C.
- Longer operating hours than modelled.
- Increased internal heat gains due to higher tenancy loads.
- More hours above 24°C compared to the weather file used for sim.
- Higher occupant density in some areas – 6–8 m^2 per person compared to 10 m^2 .
- Tenant equipment power density closer to 20 W/m^2 in some areas compared to 15 W/m^2.

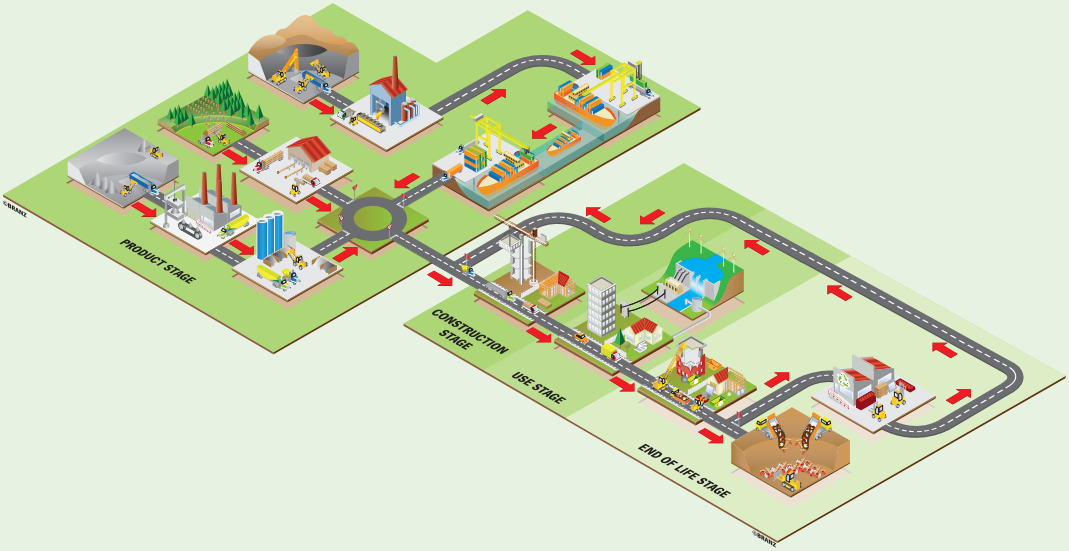
- Long fit-out period and low occupancy in early measurement months when not all systems operational.
- Energy modelling assumed high system pressure drop as worst case estimate.

- Electrical element operating 24/7 rather than business hours only.

- LED driver losses not accounted for in energy simulation.
- Time clock control for external lights initially not implemented appropriately – rectified through building tuning.
- Greater use of communal areas (stairs, change facilities).

- Tenant server rooms using more energy due to nature of business.
- Lighting controls operating less often due to tenants working outside business hours.
- Daylight dimming and controls not fully implemented – rectified through building tuning.

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 the 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

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