Towards zero-carbon construction

BRANZ's *Transition to a zero-carbon built environment* programme will continue forging partnerships in 2022 to advance knowledge and help deliver the low-carbon buildings that climate change demands.

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OVER THE PAST year, there have been many actions on climate change in the built environment in Aotearoa including MBIE's Whole-of-Life Embodied Carbon Emissions Reduction Framework, Transforming Operational Efficiency Framework and H1 revisions. Others include the Environment workstream of the Construction Sector Accord's work creating the *Constructon Sector Environment Roadmap for Action* (see page 40), Kāinga Ora's Ngā Kāinga Anamata project and the New Zealand Green Building Council's Homestar version 5.

These initiatives are challenging the building and construction industry and paving the way for zero-carbon construction to be normalised.

Going carefully ahead

The BRANZ *Transition to a zero-carbon built environment* research programme has been fortunate to assist these groups and many others with zero-carbon initiatives.

In 2021, the programme used a whakataukī 'proverb' to guide our research and engagement: a mua ata haere - go carefully ahead. The whakataukī speaks to preparation, especially in the form of developing solutions that reduce greenhouse gas emissions across a building's life cycle.

It also speaks to our engagement with stakeholders to build trust and collaboration supporting the sector to transition to a net-zero carbon economy. Preparation is also about ensuring our collective efforts have immediate impact supporting BRANZ's strategy of challenging Aotearoa to create a building system that delivers better outcomes for all by:

- helping to understand complex issues facing the sector in relation to zero carbon
- bringing about system-wide improvement in transitioning to a net-zero carbon economy
- informing solutions that facilitate behaviour change for the benefit of New Zealand.

Features of 2022 research

Key themes for research projects beginning in 2022 include the following.

Enhancing expertise to fill knowledge gaps

Research in 2022 will build on expertise gained from our previous research to address identified knowledge gaps. By enhancing research expertise, BRANZ has been able to stay at the cutting edge of knowledge and science.

BRANZ is New Zealand's leading centre for zero-carbon and building research, and our expertise and contribution to awareness around understanding of embodied

carbon in New Zealand is unparalleled. New research projects will help BRANZ continue to provide robust, quality science to industry and government stakeholders as they address the environmental impact of buildings.

Strengthening our connection to others through their needs

The second key theme focuses on strengthening our connection to others. This aligns with the BRANZ strategy of working across the building system to share expertise and work together to deliver building system goals.

This is not only about collaboration but also about co-design and ensuring our work is shaped by the needs of others to address areas of concern for industry and government. For example, the project on overheating in apartments stemmed from research undertaken by BRANZ for MBIE as part of the Building Code H1 review. We saw from this how overheating is a critical issue to solve.

The study's methodology involved co-design from stakeholders such as Kāinga Ora and Naylor Love who have been trying to practically address overheating but felt better guidance was needed. Further input was also sought from EECA and MBIE Building System Performance and the *Building for climate change* programme, incorporating their ideas into the study design and ensuring the project addresses the needs of policy makers as well.

A similar process was undertaken for the *Low-carbon retrofit solutions for our changing climate* project. Over the past year, stakeholder engagement has been undertaken to help co-design this project with organisations and to understand their needs. These include MBIE Building System Performance, New Zealand Green Building Council, Insulation Association of New Zealand, Superhome Movement, Beacon Pathway, Te Rūnanga o Toa Rangatira, New Zealand Institute of Architects and EECA. This theme has helped ensure the programme's research projects fill important knowledge gaps but also address stakeholder concerns.

Addressing key areas of concern

The new projects will contribute research addressing key areas of concern. We will assist industry and government stakeholders in meeting the challenge of climate change and the transition to zero-carbon construction.

New research projects

The new projects include the following.

Overheating in apartment buildings

Urban development is increasingly calling for greater intensification of our built environment. Previous BRANZ research observed that apartment buildings behaved very differently thermally from detached and medium-density housing, having extremely high cooling loads.

Current standards and means of compliance for clause H1 are focused on heat loss and, outside of full dynamic thermal simulation, do not provide a means of considering overheating and cooling - despite it theoretically being required by H1. This suggests a significant gap in regulation and industry awareness.

With rising temperatures and higher insulation levels, overheating is likely to get worse in all dwelling typologies.

The project will address this by providing solutions for designers, specifiers and regulators as well as occupiers.

Low-carbon retrofit solutions

Our existing housing stock needs to be warm, dry, healthy and adequately prepared for the challenges of climate change. Homes need to be resilient enough to cope with the impacts of climate change (adaptation) and reduce carbon emissions (mitigation).

Practical retrofit guidance and solutions are needed so industry can meet these requirements. This could include guidance on whole-of-house impacts of retrofitting and how to carbon footprint renovations and options such as:

- preventing overheating
- flood resilience
- higher-performance details and insulation options
- low-carbon heating and cooling
- retrofitting warm roofs and walls
- green roofs and walls.

The aim is to work with a coalition of stakeholders to provide guidance and solutions for retrofitting our existing housing stock.

Carbon footprint of fit-out

Previous research by BRANZ and Massey University found that including mechanical, electrical and plumbing, and tenant improvement or fit-out elements increases the carbon footprint of a new-build office by 31-76% compared to the base case that only includes the embodied impacts of shell and core elements.

This innovative project will fill an important gap in existing knowledge, providing information on the scale of fit-out in New Zealand commercial buildings from a climate change perspective based on case study buildings. This will allow us to:

- develop kg CO_2 eq/m² rates for fit-out elements to better understand the scale of the issue relative to other building elements
- determine where environmental hotspots are
- compare and contrast results for office and retail settings.

Environmental impacts of new construction processes

New construction processes - for example, types of prefabrication, modular and 3D printed systems - offer potential solutions to New Zealand's urgent need for fast and affordable construction. They have many advantages, but the embodied carbon systems are complex and less well understood.

This project aims to better understand the environmental impacts of the different types of new construction processes being used and emerging in New Zealand. The review will take a systems approach to consider various aspects of the construction processes, including:

- the materials involved and their current and future supply/availability
- manufacturing processes
- skills required
- consenting pathways.

The project will support the use of construction technologies that meet both New Zealand's house construction and zero-carbon targets.

NEXT home – lower-carbon stand-alone house designs

The *Low-impact buildings* project started in April 2017 when New Zealand had no Climate Change Response (Zero Carbon) Amendment Act, no MBIE *Building for climate change* programme and no recognition of embodied carbon in environmental rating tools such as Homestar.

The focus was initially on developing data and tools for use in design. These were then used to carbon footprint some case study residential and non-residential buildings and compare these to their carbon budgets - their 'allowable' emissions in line with New Zealand's commitment to restrict global average temperature rise to no more than 1.5°C.

This showed that life cycle greenhouse gas emissions of new buildings are many times over the available carbon budget.

The focus is now on facilitating the development of example lower-carbon house solutions that meet the needs of a wide range of New Zealanders and are warm, dry, healthy and able to be built at a small cost premium. Lower embodied and operational carbon strategies will be applied to case study house designs in various New Zealand climate zones, with the aim of providing drawings and accompanying technical information (including carbon footprint and indicative cost) on the BRANZ website. This could be used by industry professionals and consumers interested in designing, building and living in lower-carbon housing.

Providing new insights to help industry

These research projects will provide new insights and create new relationships that will help the construction industry transition to zero-carbon construction. As we look to the future, we want to thank the industry partners and participants who have participated in our research and to thank our key partners and programme advisory group who have supported our initiatives.

For more If you want to know more about the *Transition to a zero-carbon built environment* programme or the research projects mentioned, email us at zerocarbon@branz.co.nz.