



**Transition to a Zero Carbon Built Environment:** research, challenges and opportunities

Dr Casimir MacGregor, BRANZ



## How do new houses compare?



- Modelled emissions over 90 year service life
- Some materials missing e.g. electrical, plumbing, kitchen and bathroom units
- Current materials manufacturing technology. This should progressively decarbonise over time
- Some increase in renewables supplying grid electricity will be updating this year for ICCC and MBIE grid scenarios
- Energy simulated to maintain a temperature of 18°C 25°C. Includes heating + cooling, hot water, lighting, plug-in appliances.
- Houses 7 10 times higher than the allowable 1.5°C carbon budget (GFA basis)
- High performance houses are not necessarily low carbon houses
- Further work commencing this year

Carbon budget (occupancy basis)

### Early BRANZ climate change research

SR94 Implications of climate change for the construction sector: Houses (2000) by Michael Camilleri

First in a series of reports that focused on climate change adaptation and mitigation.

2007: Lynda Amitrano and others **An Assessment of the Need to Adapt Buildings for the Unavoidable Consequences of Climate Change** for the Australian Government Department of the Environment and Water Resources & Australian Greenhouse Office.

HEEP, BEES and Zero and Low Energy Houses (ZALEH) research

2013 *Whole of Building Whole of Life Framework* - The purpose of the framework is to establish a level playing field for evaluation and reporting of the environmental impacts of building designs in comparison with an appropriate reference building, based on life cycle assessment (LCA)

2015 *Measuring our sustainability progress: Benchmarking New Zealand's new detached residential housing stock* – a longitudinal study

# Why a research programme?

- Timing of climate change urgent.
- A need for leadership and action to bring industry along
- To help create capability for the building and construction industry to respond to climate change in an inclusive and bicultural manner.
- Create research that we *need* to help direct climate action i.e. fill in gaps in knowledge



# BRANZ

# Transition to a Zero Carbon Built Environment Aim and Objectives

**Programme aim:** By 2050 the building and construction industry is delivering net-zero carbon buildings in an affordable way. **Objective 1:** Cost effective low carbon solutions have been developed to decarbonise new and existing dwellings and non-residential buildings by 2030.

**Objective 2:** Cost-effective, low carbon solutions are routinely implemented to inform design, maintenance and construction of dwellings and non-residential buildings from 2025.

### Key stakeholders



MINISTRY OF BUSINESS, INNOVATION & EMPLOYMENT







Energy in Buildings and Communities Programme











### **Programme Advisory Group**









### **WARREN AND MAHONEY**<sup>®</sup>

THE DEEP SOUTH



National

Challenges









Te Kōmata o Te Tonga

SCIENCE



BUILDING BETTER HOMES, TOWNS AND CITIES

Ko Ngã wã Kainga hei whakamāhorahora

### The Programme in 2021

### • Enhancing expertise:

Building on past Levy investment to further programme objectives.

 Building capability to address knowledge gaps:

Strengthening under investment to accelerate research

 Supporting industry to transition to zero carbon

### Key messages

- BRANZ is **demonstrating leadership** in relation to climate action
- BRANZ is **building capability and collaborations** to address key climate change challenges.
- BRANZ has a key role to play as a **knowledge broker**.
- BRANZ uses our resources, science, experience and networks to help stakeholders achieve their goals.

### **Towards research impact**

- Development of **LCAQuick** and free training for industry
- The continued development of the Eco-Design Adviser service
- The programme provided evidence and advice to **MBIE's H1 review**.
- Working with Kainga Ora evaluating carbon, life cycle cost, energy, moisture risk to help Kainga Ora decide which of 4 construction systems will be taken forward to developed design.
- Working with the **Ministry of Education** on their Environmental Action Plan waste mini and zero carbon elements.
- Working with New Zealand Green Building Council and Passive House Institute of New
  Zealand to support industry eg handbook of high thermal performance construction details.
- A partnership to build capability with **Massey University**, School of Built Environment

### Zero Carbon BRANZ Research Portfolio

REBRI www.branz.co.nz/rebri Reducing the amount of building material waste.

> **Regional waste** minimisation

Understanding construction and demolition waste in NZ.

BEES 1

Building Energy End-use Study

consumption of nonresidential

Stage 1: Energy and water

buildings in New Zealand.

BEES 2.0 🗘 BEES Stage 2: Energy demand and flexibility within non-residential buildings.

Home heating left cold 🕻 Researching the best ways to use heat pumps in different types of homes in New Zealand.

#### HEEP1

Household Energy End-Use Project (HEEP) Stage 1: Measuring and modelling the way energy is used in New Zealand households, 1996-2010.

Level www.level.org.nz Designing and building sustainable homes.

SCMs in concrete production 🗘 Using alternate supplementary cementitious materials (SCMs) such as post-industrial or natural source pozzolans to replace a proportion of Portland cement.

### PRODUCT STAGE

### **ALL STAGES**

#### Whole-building whole-of-life framework

impact across the life cycle.

Measuring sustainability 🔅 Tools and resources to calculate potential A longitudinal study benchmarking environmental impacts of New Zealand buildings across the building life cycle where NZ stands as a nation in using life cycle assessment. terms of residential sustainability. looking at both impacts of, and Marginal abatement cost curves impacts on, new builds. scoping 🗘

Get ready! 🗘 Understanding how building and construction businesses are preparing to transition to zero carbon.

Carbon budget 🌔 buildings, based on allowable greenhouse gas emissions to

Assessing a simple visual representation of the dollar cost of different carbon abatement Maintaining and updating the strategies per tonne of carbon saved. environmental impact data behind BRANZ CO,NSTRUCT Low-impact buildings 🗘 and LCAQuick. How we can shift to buildings with net-zero

HEEP2 () HEEP Stage 2: Update of HEEP 1 -

how, where, when and why energy is

used in New Zealand homes. 2019-

Developing carbon budgets for 2050 to keep global temperature rise to no more than 1.5°C.

Keeping carbon current 🔅

BRANZ CO<sub>s</sub>NSTRUCT 🗘 Tool that provides values for embodied greenhouse gas and energy for some construction materials.

> LCAQuick Tool to calculate the environmental impacts of buildings across their life cycle.

#### The MaCC Tool 🔅

Materials and Carbon Comparison Tool for comparing the materials-related carbon footprint of residential wall, floor and roof constructions drawn from BRANZ House Insulation Guide.

Innovative low-carbon residential water heating solutions 🗘 Comparing new water heating systems to the 'bestcase' technologies for New Zealand.

**Energy and carbon** 

certificates for dwellings 🔅 Standardising New Zealand dwelling certification for nation-wide energy and carbon assessment.

CIIO

N STAGE

Current projects (

### **Research addressing low carbon solutions**

- Reducing GHG emission reduction in new buildings:
  - Low impact buildings project
  - Innovative low carbon residential water heating solutions
  - Marginal abatement cost curves (Part 1 and Part 2)
  - Supplementary cementing materials in concrete production (Concrete New Zealand)
  - Bio-based materials- NZ wood fibre insulation proof of concept
  - How can materials and durability contribute to future zero carbon buildings
  - Scoping for next generation carbon footprinting tools
  - Carbon Case for Resilient Design Rosa Gonzalez (UoA) PhD scholarship
  - Designing Low Carbon Architecture in NZ Emily Newmarch (VUW) PhD scholarship

### **Reducing GHG reduction in existing buildings**

- Energy and Carbon Performance Certificates (residential)
- BEES addressing energy demand
- Heat pump efficiency project (residential)
- Decision making tool for zero carbon refurbishment (Massey University)
- Measuring our sustainability progress (second update)
- Housing stock strategies for meeting NZ's 2050 carbon target
- Towards a New Zealand Building Stock model
- Seismic Design and retrofit of Hillside houses

### **Implementing change**

### Transition pathways:

- Get ready preparing building and construction businesses for the transition to zero carbon (with University of Otago Business School)
- The Future of Work- skills, competencies and expertise needed to transition to zero carbon
- Roadmap to a solution for evaluating building performance for low carbon homes
- Supporting Industry stakeholders:





### **Education 2021**

- Nationwide seminar series on carbon: 21 centres Oct/Nov 2021
- Seminar for NZIA Auckland August 2021
- Webinars:
- Sustainable materials (September 2021)
- LCAQuick (October 2021)
- Videos: series of 5 videos on designing low-carbon houses (October 2021)

# Thank you

### Contact us: zerocarbon@branz.co.nz

#### **Dr Casimir MacGregor**

Senior Social Scientist

Programme Leader, Transition to a Zero Carbon Built Environment

casimir.macgregor@branz.co.nz

#### **Dr David Dowdell**

Principal Scientist- sustainability

Programme Science Leader

david.dowdell@branz.co.nz

https://www.branz.co.nz/environment-zero-carbon-research/