BRANZ

The Carbon Challenge - Science and solutions

Live webinar series

Webinar 3

Upcoming webinars

Webinar 4 Wednesday 30 March 12–1

- Design and build a low-carbon dwelling

BRANZ

About us

David Dowdell

Greg Burn

BRANZ

Sponsors

Firth

Kingspan. | Thermakraft™

KNAUF INSULATION

NZGBC
TE KAUNIHERA HANGANGA TAUTAIAO

Resene
the paint the professionals use

™ XLAM

Supported by
Building Research Levy

Questions

There will be a separate question and answer session from 1.30–2.30pm following this webinar

BRANZ

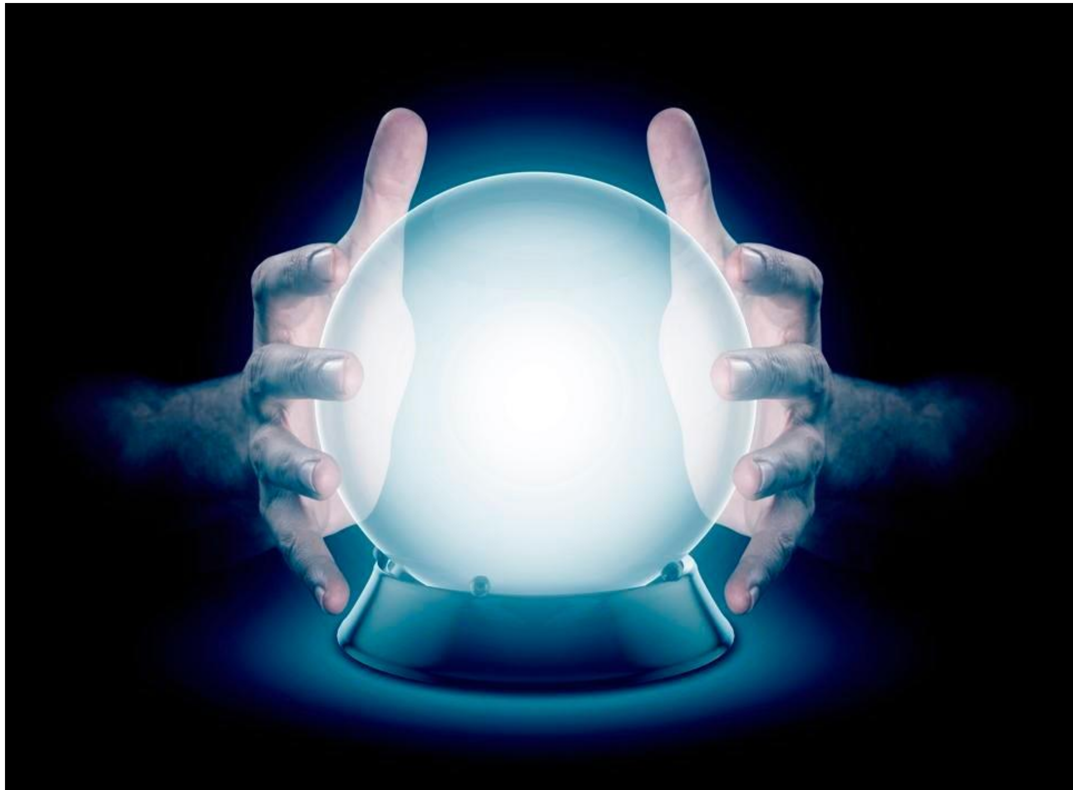
Programme

- Carbon challenges

Webinar content

- Research/modelling/science based
- Primary focus on volume residential
- Continually evolving situation
- Realism – carbon emissions reduction represents a challenge to the industry

- We have left it really late – we need to act now!!



BRANZ

BRANZ

Carbon challenges

Climate change mitigation and adaptation

Mitigation – impact that buildings have on climate change

Adaptation – impact that climate change has on buildings

Overheating
Flooding
Sea-level rise
Extreme weather events

BRANZ

Embodied and operational carbon emissions

Embodied carbon emissions:
- Can largely occur before owners occupy the house
- Design/specification influenced

Operational carbon emissions:
- Occur progressively over time
- Design/specification/occupier influenced

Focus has been on energy efficiency
Don't ignore embodied emissions!

BRANZ

Considerations to reduce carbon emissions

Whole-of-life embodied carbon emissions:

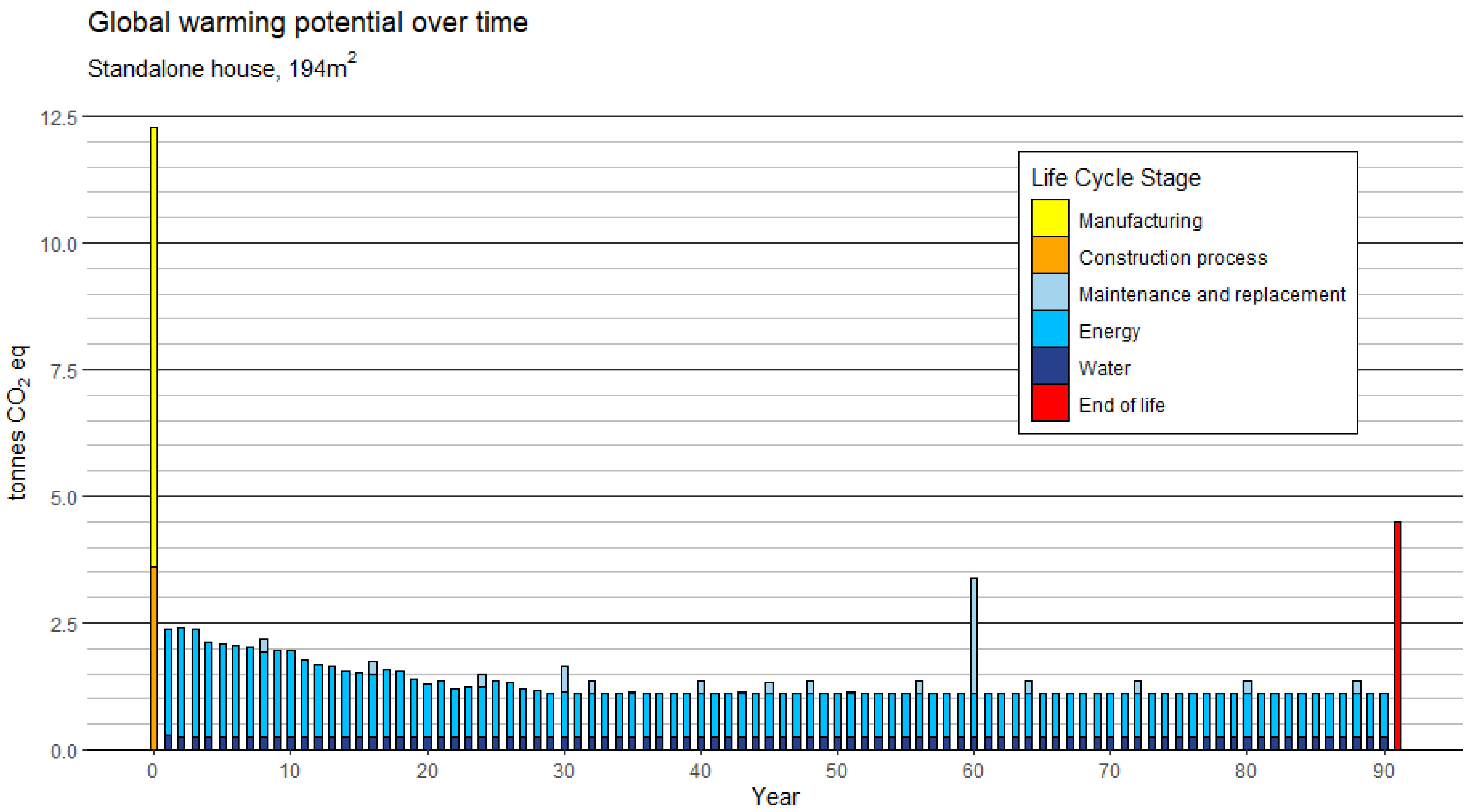
- New build efficiency – upgrade/repurpose existing buildings, reduce new building sizes
- Material efficiency – material efficient design, reducing waste
- Carbon intensity – lower embodied carbon materials

Operational emissions:

- Energy demand
- Reticulated water demand
- (Occupancy)

BRANZ

Timing of greenhouse gas emissions



BRANZ

Need a carbon footprint tool …

… to calculate whole-of life embodied and operational carbon emissions

Tools should be:

- Easily understood and easy to use
- Common across the industry
- Consistent (scope, methodology, assumptions)
- Thorough
- Use the same data sources/defaults
- Low cost/free

Ideally, cover a range of performance requirements

Currently, no tool meets all these criteria

NZGBC HECC Tool

LCAQuick

One Click LCA

eTool
Analysis software for sustainable design

BRANZ

… with a comprehensive dataset for carbon footprinting

Carbon footprinting is data intensive

We don’t have perfect data – but can’t afford to wait!

Data must be:

- Comprehensive (cover the full life cycle)
- Accessible/transparent
- Able to be used to compare designs
- New Zealand relevant
- Current/regularly updated

BRANZ

Environmental product declarations (EPDs)

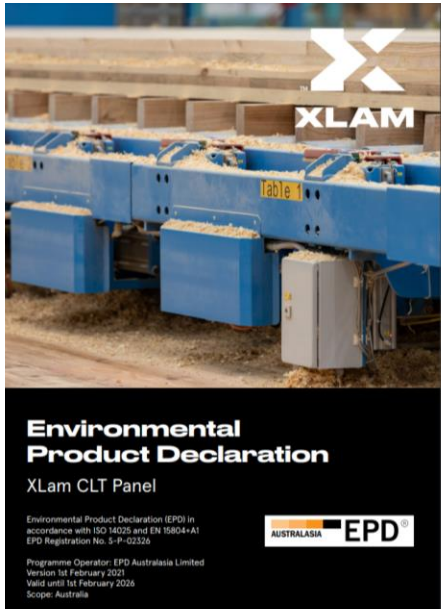
Robust, scientifically-based, third-party verified declarations of environmental performance of construction materials

Produced by construction product manufacturers in accordance with international standards and based on LCA

EPDs provide a valuable source of data that can feed directly into building LCA

EPD Australasia
www.epd-australasia.com

Please ask for them!



BRANZ

Generic data

Where EPD data is not available, we use generic data (EcoInvent)

"New Zealandise" the data – e.g. add NZ grid electricity to process data

Useful for stages of the life cycle beyond materials manufacture:

- Transport by truck/ship
- End-of-life processing/disposal

As more EPD data becomes available, can use to replace or supplement generic data

ecoinvent

Trust in Transparency

BRANZ

Estimate of material quantities

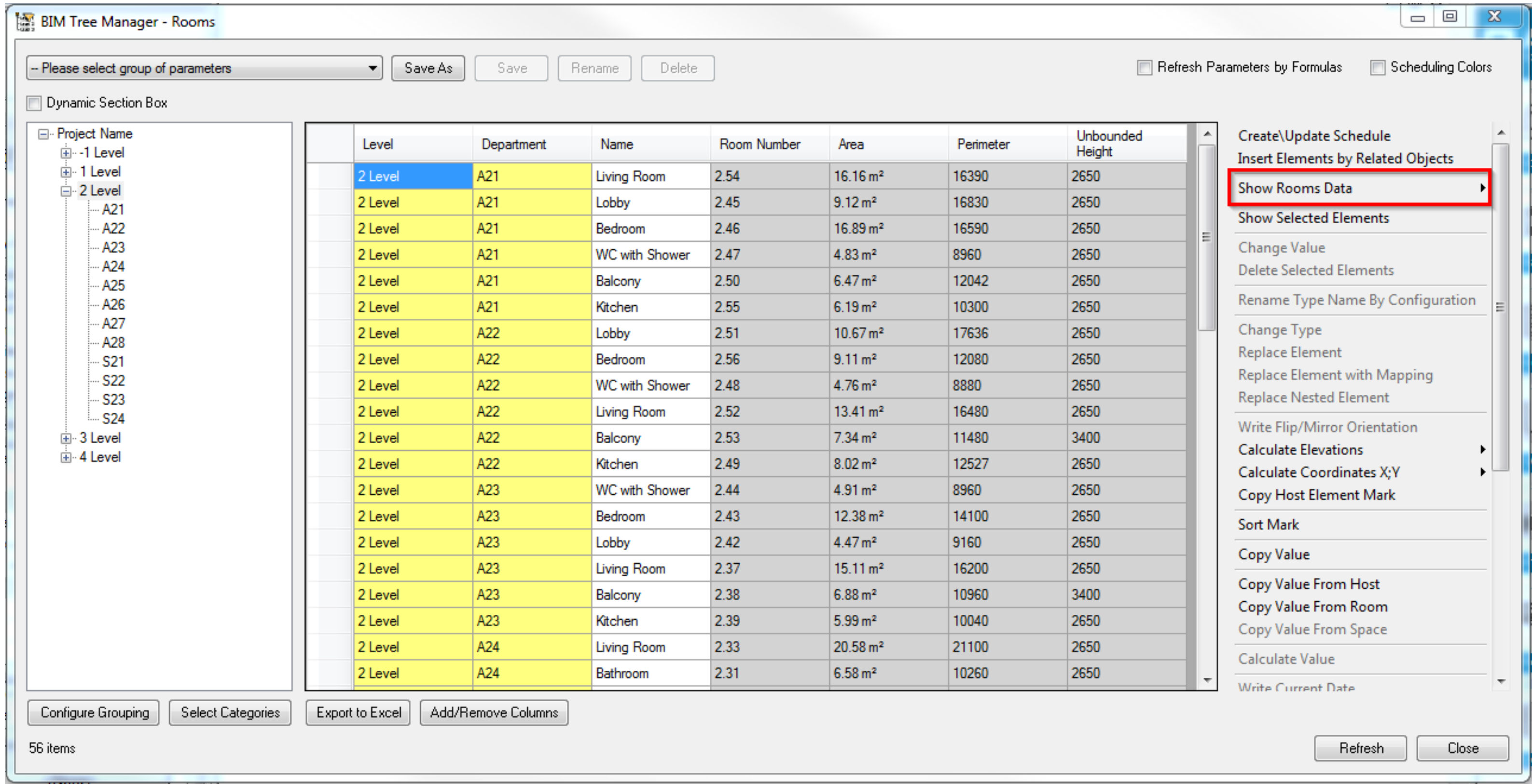
Residential – CO_2RE and HECC require m² of elements (Webinar 2)

Otherwise, embodied carbon footprint/LCA tools require material quantities:

- BIM
- Schedule of quantities

Need to ensure quantities are:

- Comprehensive
- Accurate



Material performance

Low-carbon building materials/components that are:

- Fit for purpose
- Durable
- Cost-effective/comparable
- Low-waste/recyclable
- Readily available

Build cost – affordability

Cost comparable lower-carbon materials

Managing costs related to:

- Increased R-value envelope insulation/exterior joinery
- Heating/cooling/ventilation requirements for IEQ
- Water harvesting/storage

Ensure extra cost improves performance *and* reduces emissions

BRANZ

Striking a balance

To reduce operational emissions, houses must become more energy efficient

This means:

- Smaller/simpler floor plans
- Lower glazing ratios
- Higher construction R-values
- Being more airtight
- Reduced thermal bridging

BRANZ

Healthy and liveable

Energy-efficient houses must also have good IEQ

This means:
- Heating **and cooling** for comfortable year round internal temperatures
- Being well ventilated with sufficient air changes and managed humidity
- Considering thermal mass

BRANZ

Increased exterior envelope airtightness

BRANZ suggested build target of 3 air changes per hour (ach) maximum at 50 pascals (3 ach @ 50 Pa is a test pressure – equates to 0.15 ach actual)

Most current new builds easily measure 5 ach @ 50 Pa

Increased airtightness:

- Reduces infiltration heat loss/gain
- Improves ability to maintain comfortable internal temperature and IEQ when mechanical ventilation/heating/cooling is incorporated

BRANZ

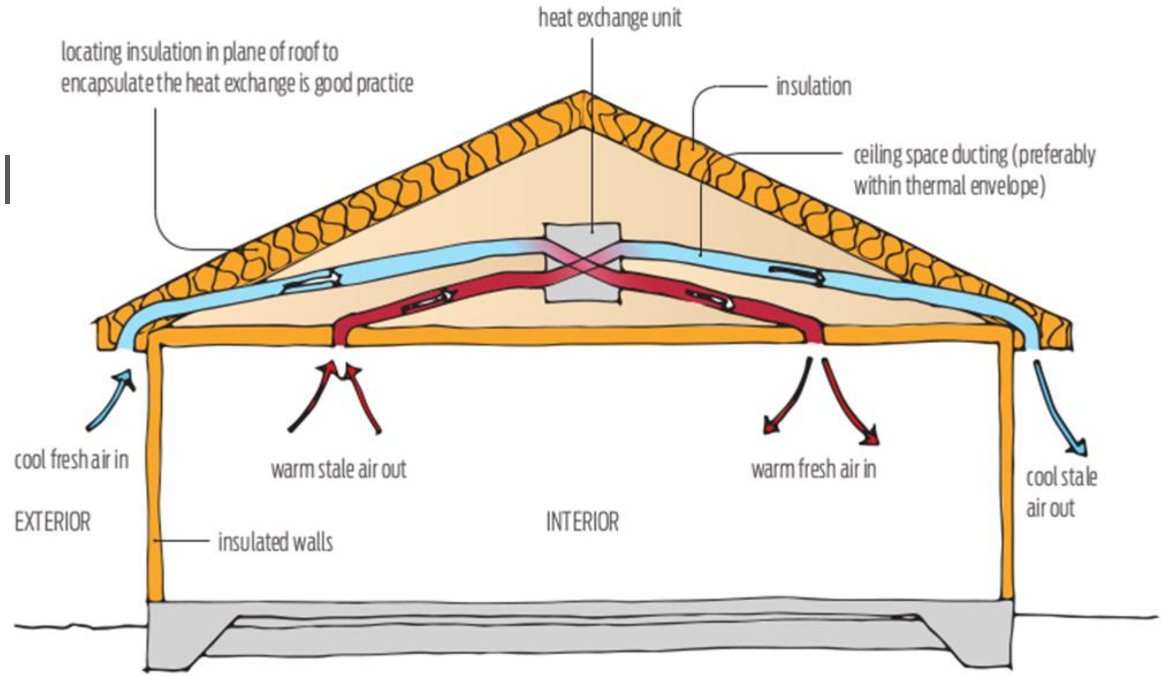
Need for supplementary ventilation

A healthy indoor environment requires 0.35–0.5 ach actual

Increased envelope airtightness (0.15 ach actual) requires an effective whole-house mechanical ventilation system (to supplement natural ventilation) to ensure that the home is not underventilated

Ventilation system should incorporate heating *and* cooling of replacement air

Embodied/operational carbon cost of mechanical ventilation needs consideration



BRANZ

Mechanical ventilation

Mechanical ventilation means heat losses from ventilation are more predictable and can be factored in to modelling

Whole-house mechanical ventilation including heat recovery is efficient
Heat recovery ventilation is *even more efficient* in airtight, highly insulated houses

Mechanical ventilation system considerations:
- Coefficient of performance (COP)
- Energy efficiency ratio (EER)

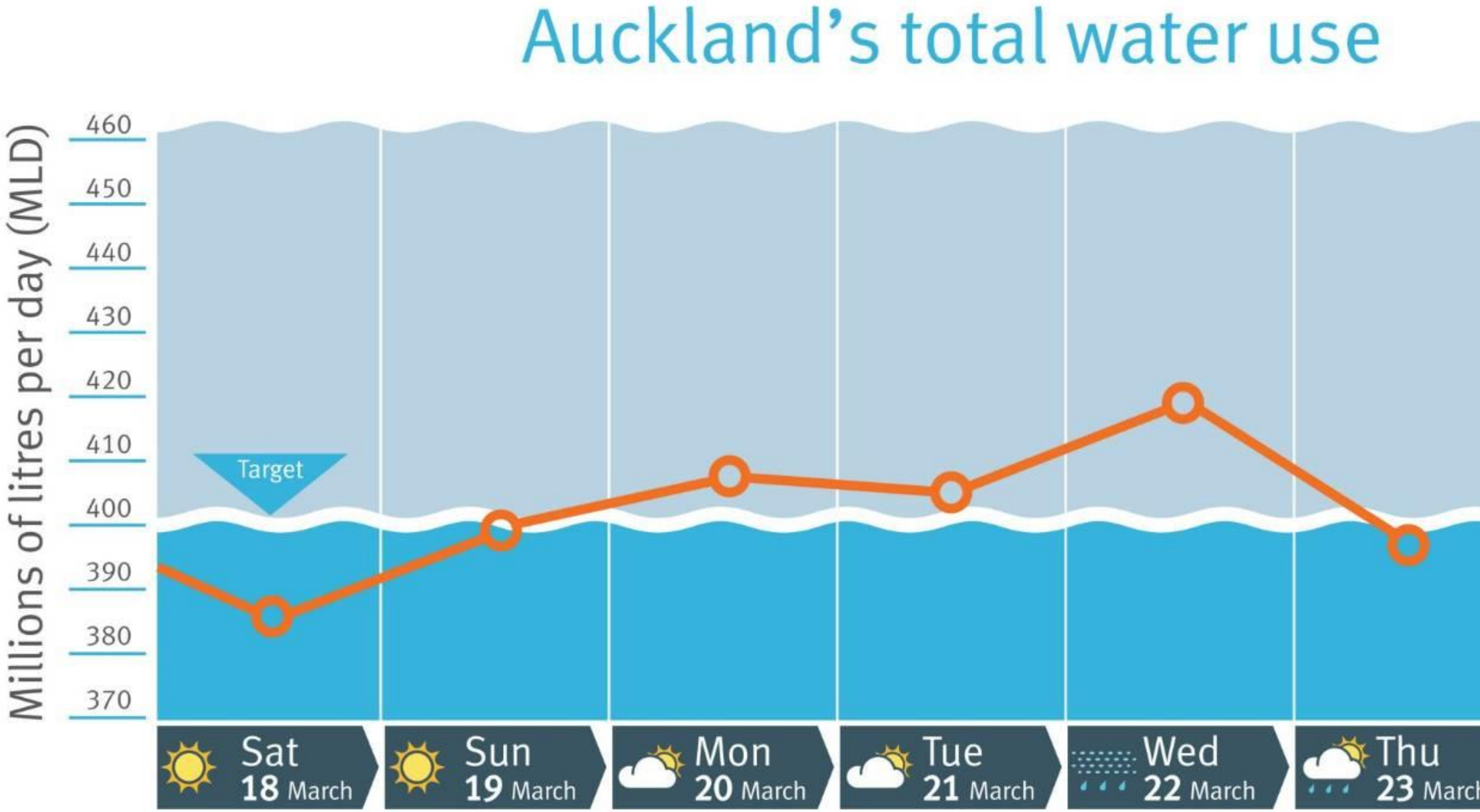
BRANZ

Changing occupant behaviour

Effectively manage heating/cooling/ventilation (IEQ)

Reduce the use of:

- Grid-supplied energy
- Reticulated water



Exterior wall framing ratio

Beacon/BRANZ research identified substantially more framing in timber-framed exterior walls than expected

Higher framing ratio = more thermal bridges = more heat loss/gain

14–18% presumed for H1 *Energy efficiency*

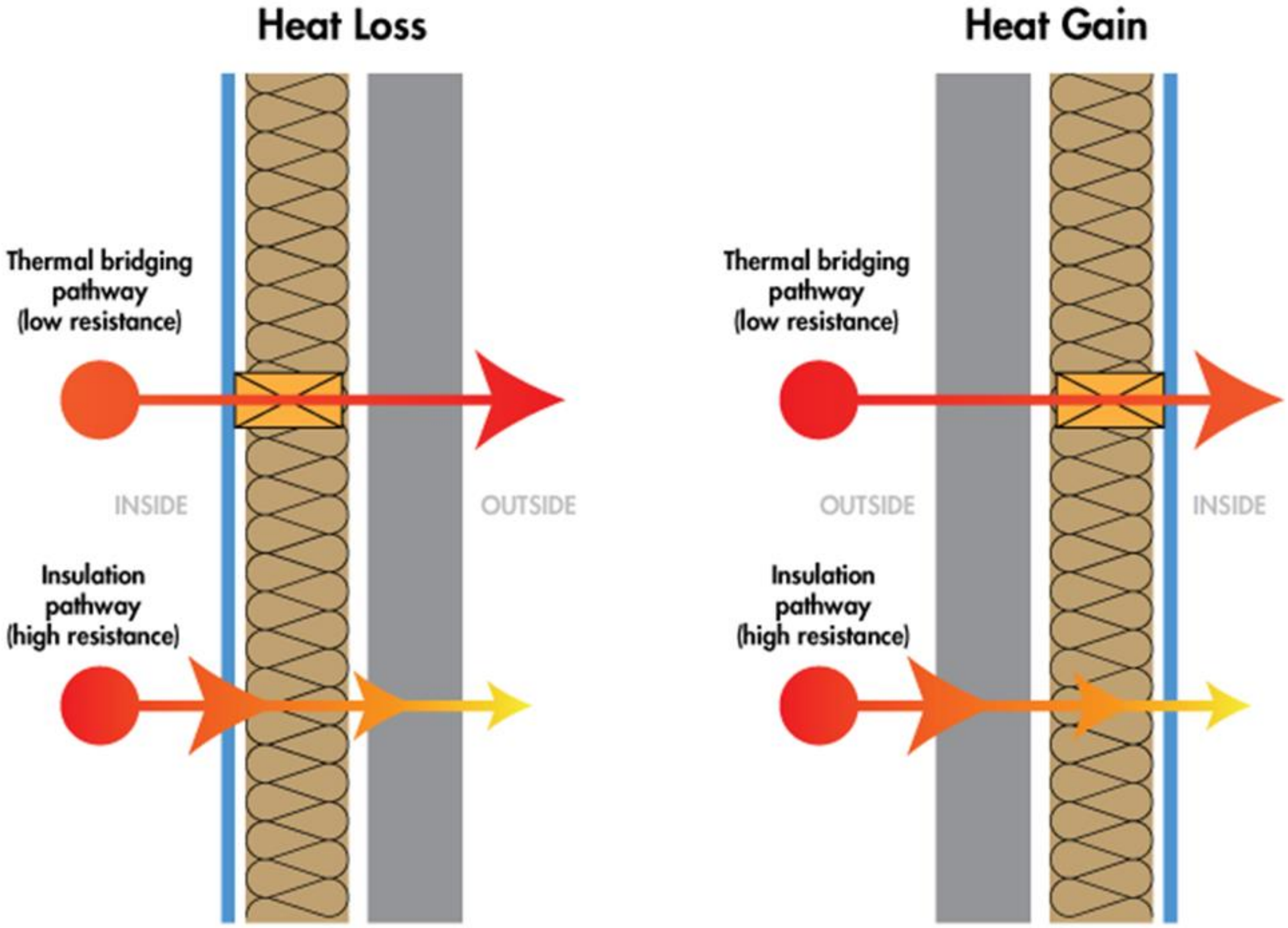
Average from research 34% (24 –57% range)

Up to 100% in short wall frames

BRANZ

Thermal bridging

Major area of heat loss/gain through exterior wall framing



Thermal bridging

Other issues:

- Structural steel exterior wall brace frames
- Cavity battens often replicate wall framing (complete thermal bridge)
- Too many exterior wall nogs/dwangs
- Concrete slab perimeter edge

BRANZ

Insulation issues

Beacon/BRANZ research also identified:

- Uninsulated exterior wall area as high as 3%
- No insulation in corners or where internal walls meet external walls
- Mid-floor framing and lintels form a completely uninsulated band
- Uninsulated (unsealed) gap at bottom plates (due to plastic packers)

BRANZ

Site and subdivision

Site sizes
Orientation
Density combinations
Roading
Shading
Consideration of passive design principles

Medium-density housing

Need to do intensification well

Often difficult to achieve suitable dwelling/glazing orientation due to:

- Site orientation (yield, roading, site sizes)
- End elevations only to internal units
- One dominant elevation to end units
- Impact of adjacent buildings

Consider energy modelling

BRANZ

Changing current practices

Design:
- Poor orientation/overglazing
- Complexity
- Minimum compliance only
- Lack of innovation

Construction:
- Poor insulation installation
- Material waste

BRANZ

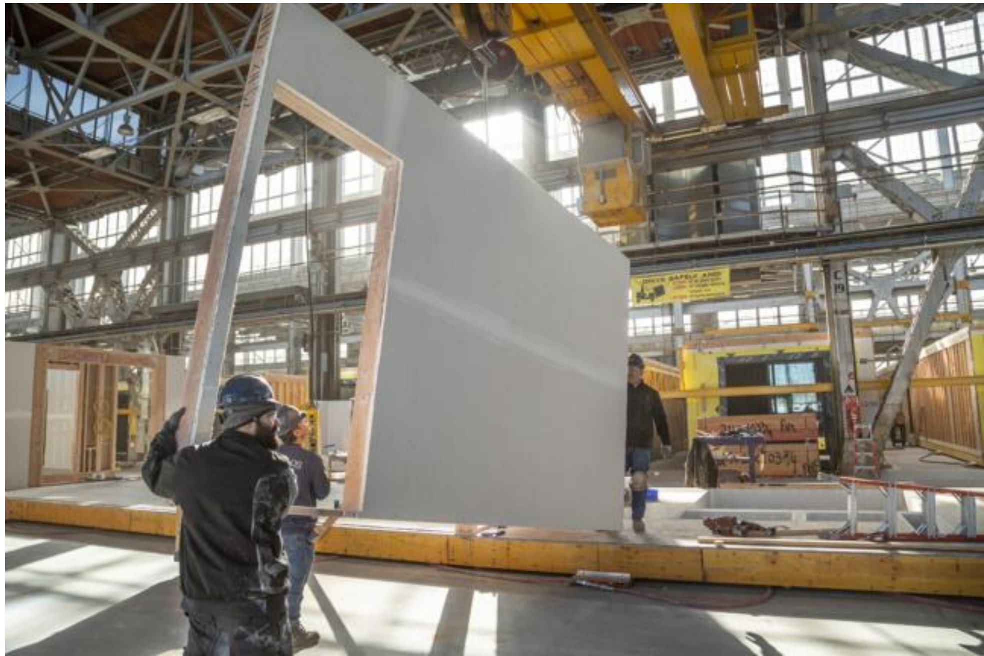
Designing out waste

Reduce:

- Dwelling size
- Design complexity
- Material range

Consider:

- Modular design
- Factory build/prefabricated components



BRANZ

Reuse and recycle building materials

High-quality, durable demolition materials going to waste

Embodied carbon already emitted

Compliance issues

Repurpose existing buildings

Can result in reduced:

- Quantities of new materials
- Build costs
- Land use
- New infrastructure
- Waste to landfill
- Embodied carbon emissions

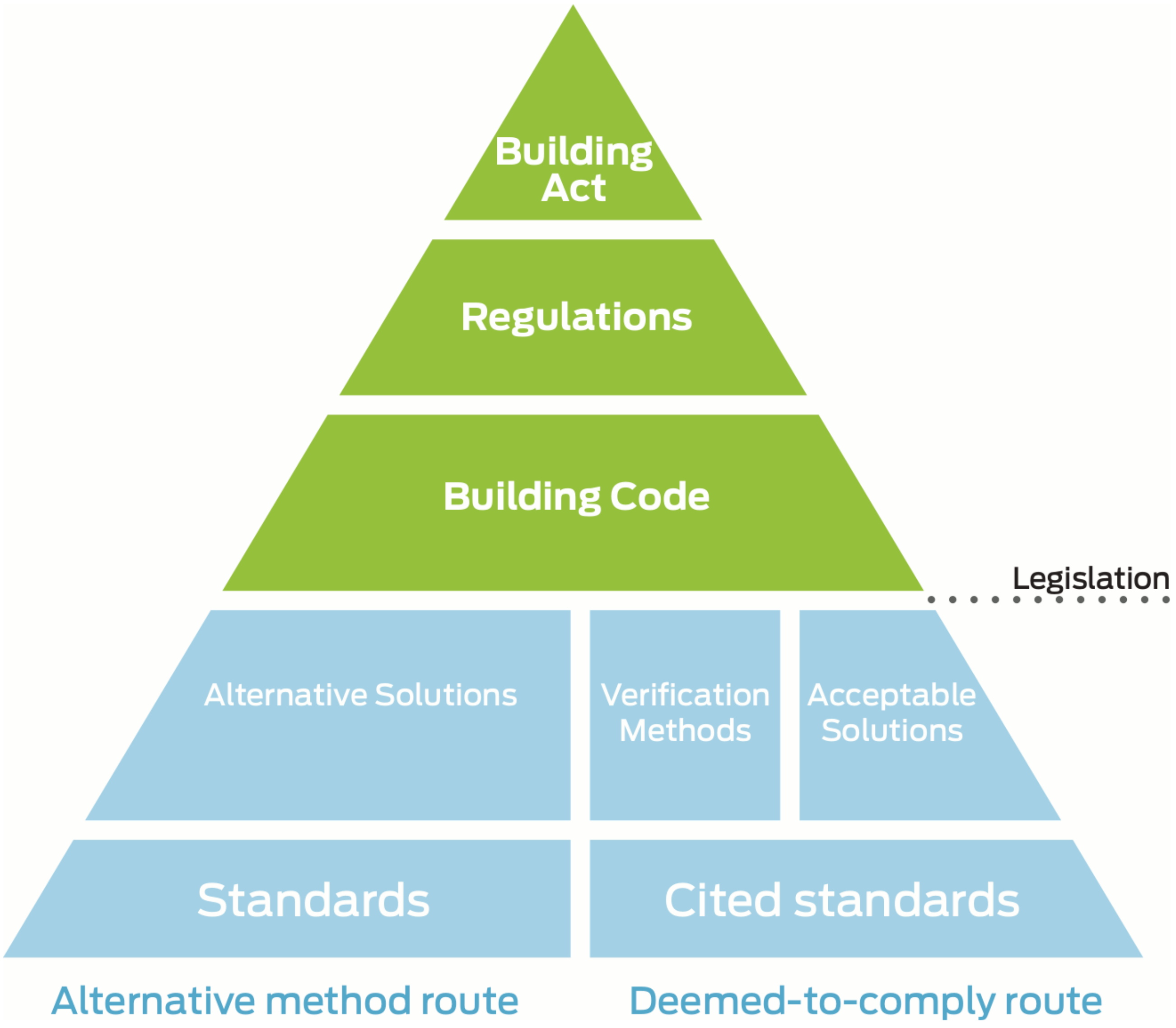
BRANZ

Alternative Solutions

Performance-based Building Code
Acceptable Solutions non-mandatory

Opportunity for innovation
Challenge the norm

Think carbon – but don't let it overrule



BRANZ

Key messages

Key messages

- Wide range of relevant challenges (opportunities)
- Imperfect information and data gaps – but can't afford to wait
- Need to change some current practices (now)

Key organisations

A number of organisations are focused on improving building performance:

- NZGBC
- Passive House Institute New Zealand
- Eco Design Advisors
- SUPERHOME movement
- Lifemark
- Beacon Pathway
- BRANZ

BRANZ

Useful links

BRANZ zero-carbon built environment research programme
www.branz.co.nz/environment-zero-carbon-research/transition/

Building LCA
www.branz.co.nz/buildinglca

CO_2NSTRUCT
www.branz.co.nz/co2nstruct

LCAQuick:
www.branz.co.nz/lcaquick

Building LCA case studies
www.branz.co.nz/pubs/case-studies/lcaquick/

Datasheets
www.branz.co.nz/buildinglca (and select 'Data')

Contact: david.dowdell@branz.co.nz

Thanks again to our sponsors

Upcoming webinars

Webinar 4 Wednesday 30 March 12–1

- Design and build a low-carbon dwelling

BRANZ

Thanks

We really appreciate the effort you have made to attend

BRANZ

BRANZ