

[2.0]



**Solution.**

THINK · TALK · CREATE

CARBON TOOLS

WEBINAR SERIES

## Upcoming webinars

### Webinar 3 Wednesday 25 May 12–1pm

- Life cycle assessment – an overview

### Webinar 4 Wednesday 1 June 12–1pm

- NZGBC: Homestar Embodied Carbon Calculator (HECC)

### Webinar 5 Wednesday 8 June 12–1pm

- LCAQuick



# Previously

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## Webinar 1 Wednesday 11 May

- LCAPlay

## Carbon Challenge – Science and Solutions webinars (March 2022)

- Carbon and the New Zealand construction industry
- Compliance and calculating building carbon footprints
- Carbon challenges
- Design and build a low-carbon dwelling

[www.branz.co.nz/pubs/previous-webinars/](http://www.branz.co.nz/pubs/previous-webinars/)



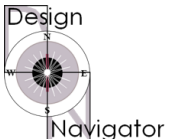
# About us

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Dave Dowdell, BRANZ

Albrecht Stoecklein, Design Navigator

Lindsay Wood, Resilienz Ltd and Resilienz Climate Trust





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# Questions

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Please feel free to ask questions by using the Chat feature

We will take questions at the end of the webinar



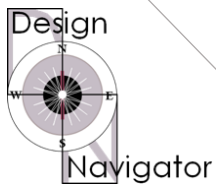
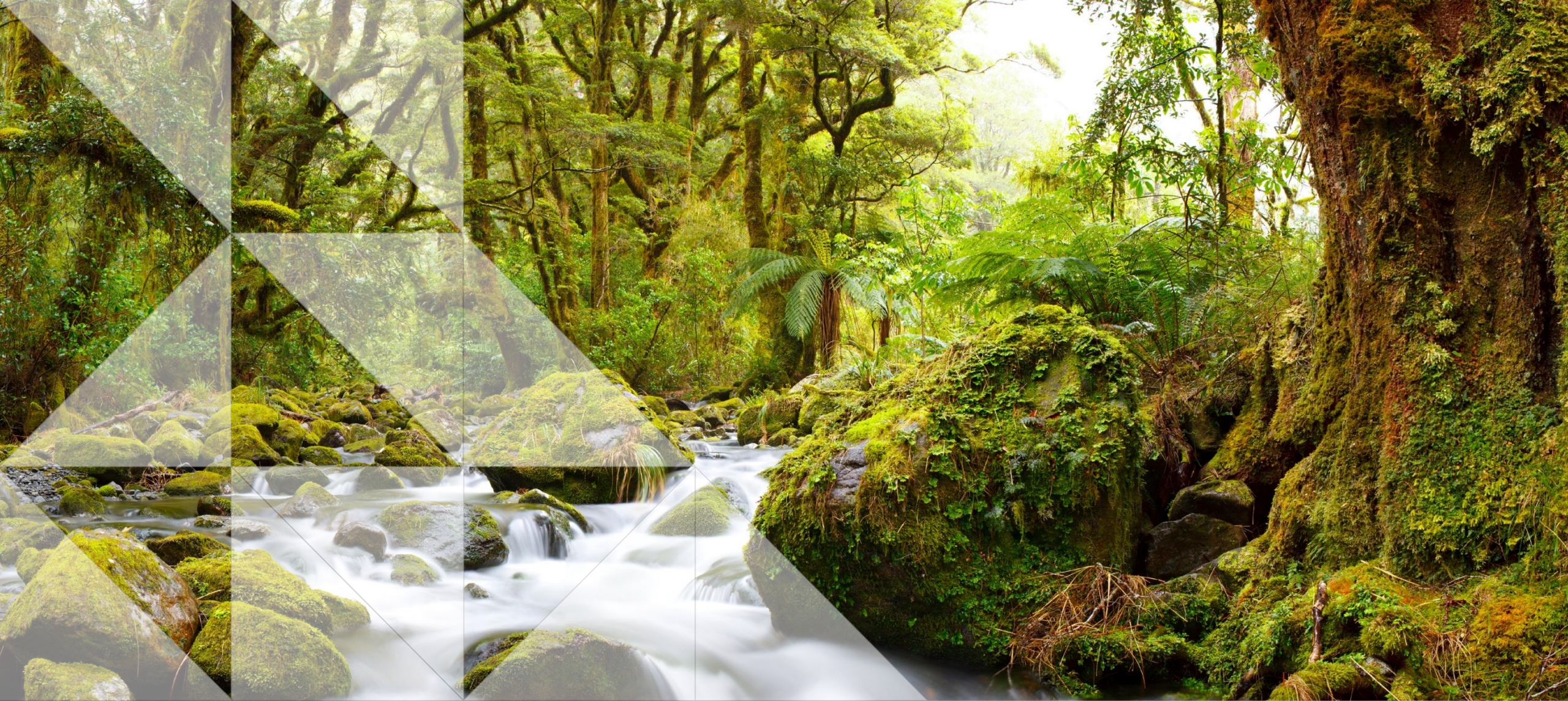


# Programme

- Background to CO<sub>2</sub>RE
- CO<sub>2</sub>RE demonstration
- Material quantities development







# Background to CO<sub>2</sub>RE



# What is CO<sub>2</sub>RE?

Carbon dioxide (CO<sub>2</sub>) in Residential (R) Elements (E)

Free tool to facilitate comparison of residential elements on the basis of construction R value and **whole-of-life embodied carbon**

Applicable if you don't know what constructions to use – or if you do

Focuses on wall, floor and roof constructions from:

- BRANZ *House insulation guide* (5th edition) – most constructions included
- PHINZ *High-performance construction details handbook* – most commonly used elements <https://passivehouse.nz/>

Primarily stand-alone housing



# Intent

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CO<sub>2</sub>RE can help you to:

- Identify lower whole-of-life embodied carbon wall, floor, roof constructions based on m<sup>2</sup> rates
- Compare constructions for construction R-value and whole-of life embodied carbon
- Understand how variants in specific constructions affect construction R-value and whole-of-life embodied carbon
- Understand potential emissions at different life cycle stages

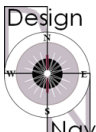
# Intent

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CO<sub>2</sub>RE can help you to:

- Understand how other variables can impact whole-of-life embodied carbon:
  - Exposure zone
  - Higher-carbon concrete or lower-carbon concrete (using SCMs)
  - Timber/engineered woods from responsible forestry management schemes – **biogenic carbon**
  - Inclusion of wider benefits by diverting waste from landfill (module D)

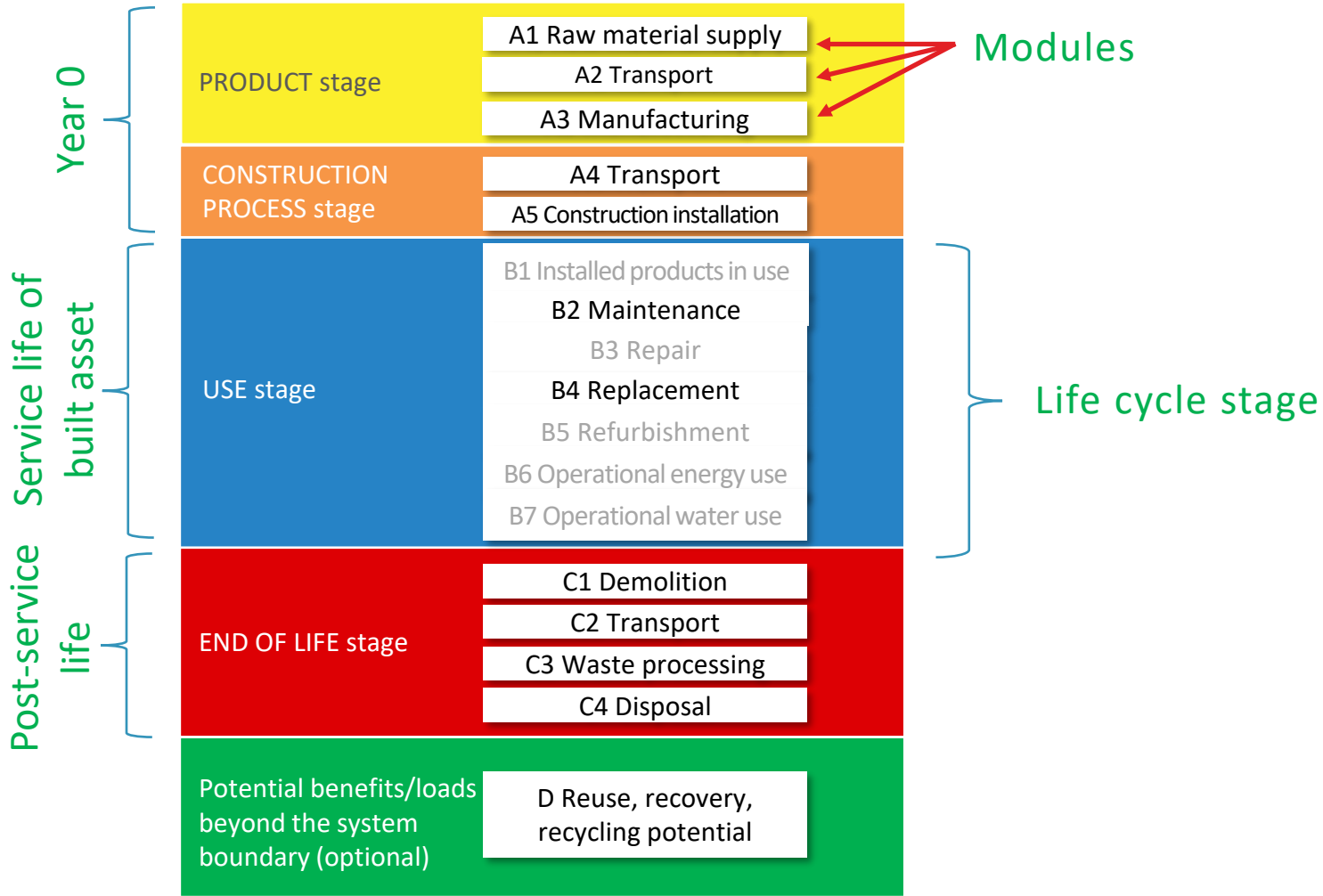
Synergy with NZGBC Homestar Embodied Carbon Calculator (HECC) – contains same data for walls, floors, roofs [**Webinar 4** 1 June 12–1 pm]





# Whole-of-life embodied carbon

Based on international standards **EN 15978** and **ISO 21931**



# Scope

Number of constructions:

	BRANZ HIG	PHINZ HPCD
Roof	18	2
Wall	45	1
Floor	14	1

Most constructions feature variants, e.g. insulation R-value, framing ratio, A/P ratio (accessed using dropdown menu)

Able to tailor options, e.g. with/without biogenic C, module D, high/low=carbon concrete, exposure zone

Pragmatism/judgement was needed concerning inclusions/exclusions

# Where is the whole-of-life embodied carbon in a house?

Roof	%
Pre-occupation	9
Post-occupation	9

Exterior walls	%
Pre-occupation	12
Post-occupation	6

Interior walls	%
Pre-occupation	2
Post-occupation	2

Interior finishes	%
Pre-occupation	3
Post-occupation	22



Windows/doors	%
Pre-occupation	6
Post-occupation	9

Midfloor	%
Pre-occupation	2
Post-occupation	<1

Floor slab	%
Pre-occupation	17
Post-occupation	1

Pre-occupation = product manufacture + transport/installation  
 Post-occupation – maintenance/periodic replacement of materials, end of life  
 % = % of whole-of-life embodied carbon



# Methodology

90-year residential service life (BRANZ methodology)

More recently, MBIE BfCC published embodied carbon technical methodology (February 2022)

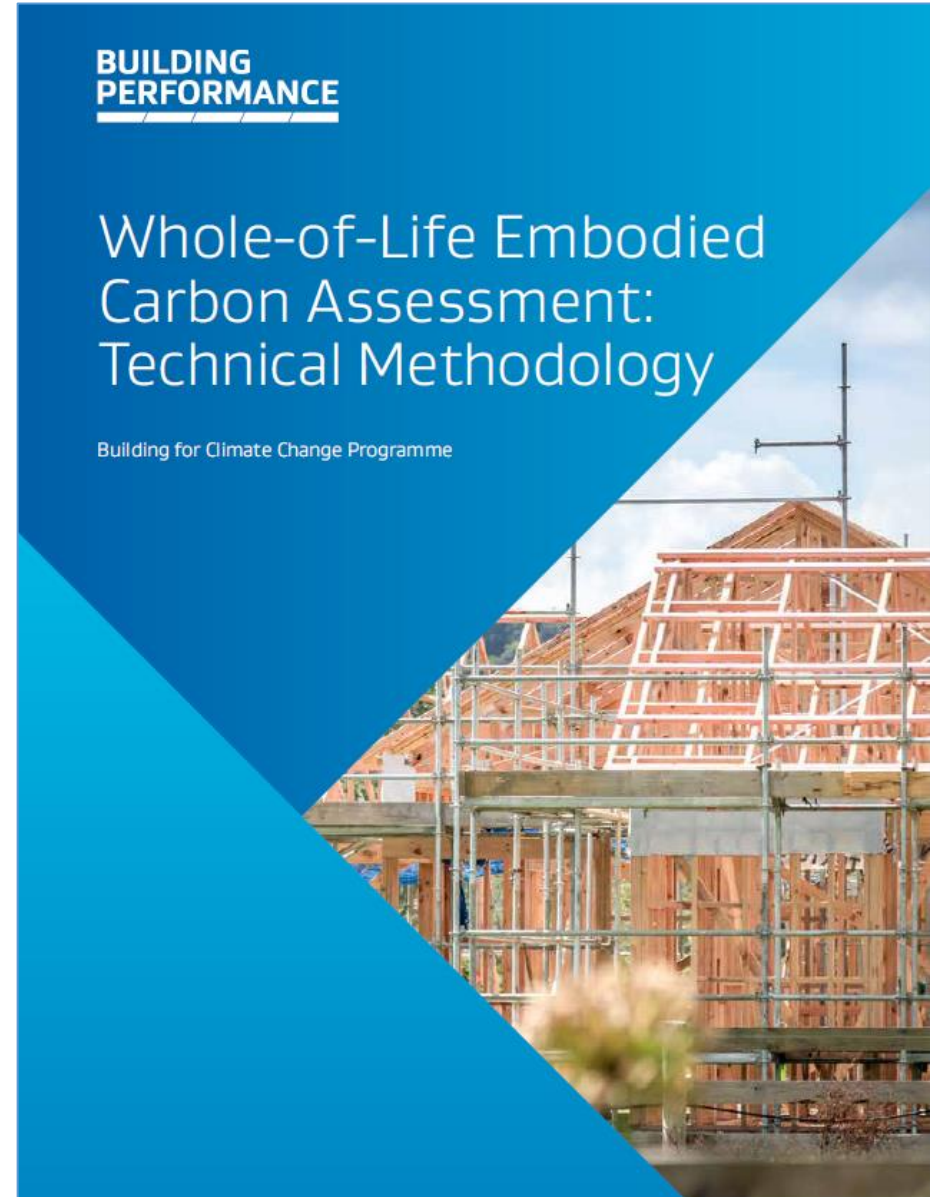
[www.building.govt.nz/getting-started/building-for-climate-change/](http://www.building.govt.nz/getting-started/building-for-climate-change/)

50-year service life

Implications of 90 years compared to 50 years:

- Absolute numbers higher (more maintenance, replacement of materials)

Aiming to align in next iteration



# MBIE embodied carbon emissions reduction framework

Three main objectives:

- New build efficiency
- Material efficiency
- **Carbon intensity** (CO<sub>2</sub>RE addresses this)



Materials and quantities in constructions – Lindsay

Whole-of-life embodied carbon by life cycle stage – CO<sub>2</sub>NSTRUCT, LCAQuick database – supported by scenario data in BRANZ datasheets:

- Generic transport distances to construction site
- Waste rate in construction
- End-of-life route(s) for waste materials from construction
- Maintenance of materials
- Replacement of materials during building service life – material service life
- End-of-life route(s) for waste materials from demolition



## Some limitations

Primarily roof, wall, ground floor constructions from BRANZ *House insulation guide* (5th edition) (HIG)

Uses BRANZ datasheets so values cannot be adjusted, e.g. transport distance to construction site (based on Auckland), generic waste rates.

Biogenic carbon not shown separately

Framing ratio based on HIG – recent research shows framing ratios higher in reality

Construction R-values exclude junctions with other elements

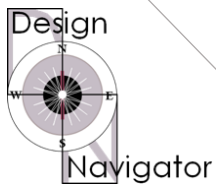
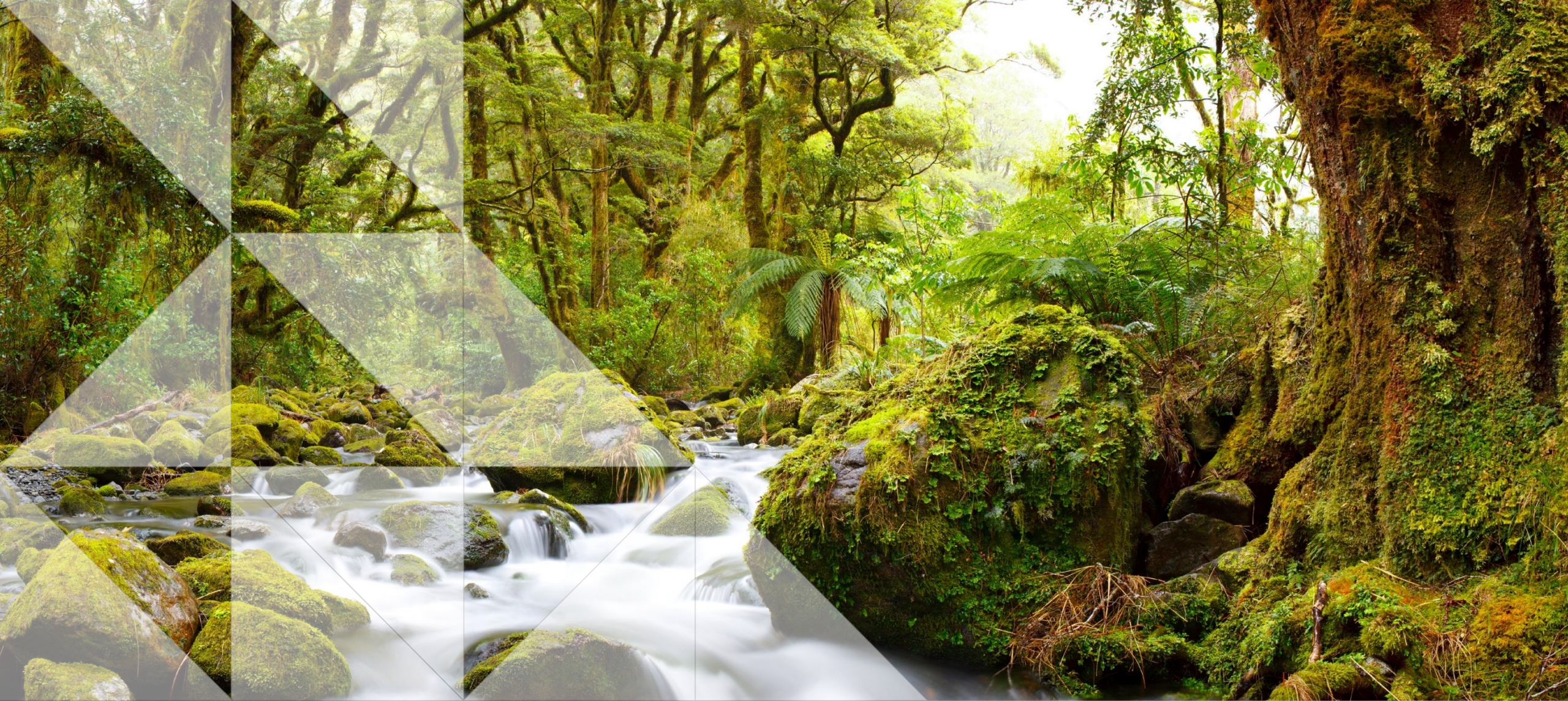
# Tool location

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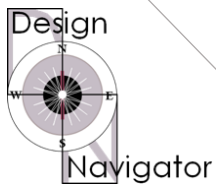
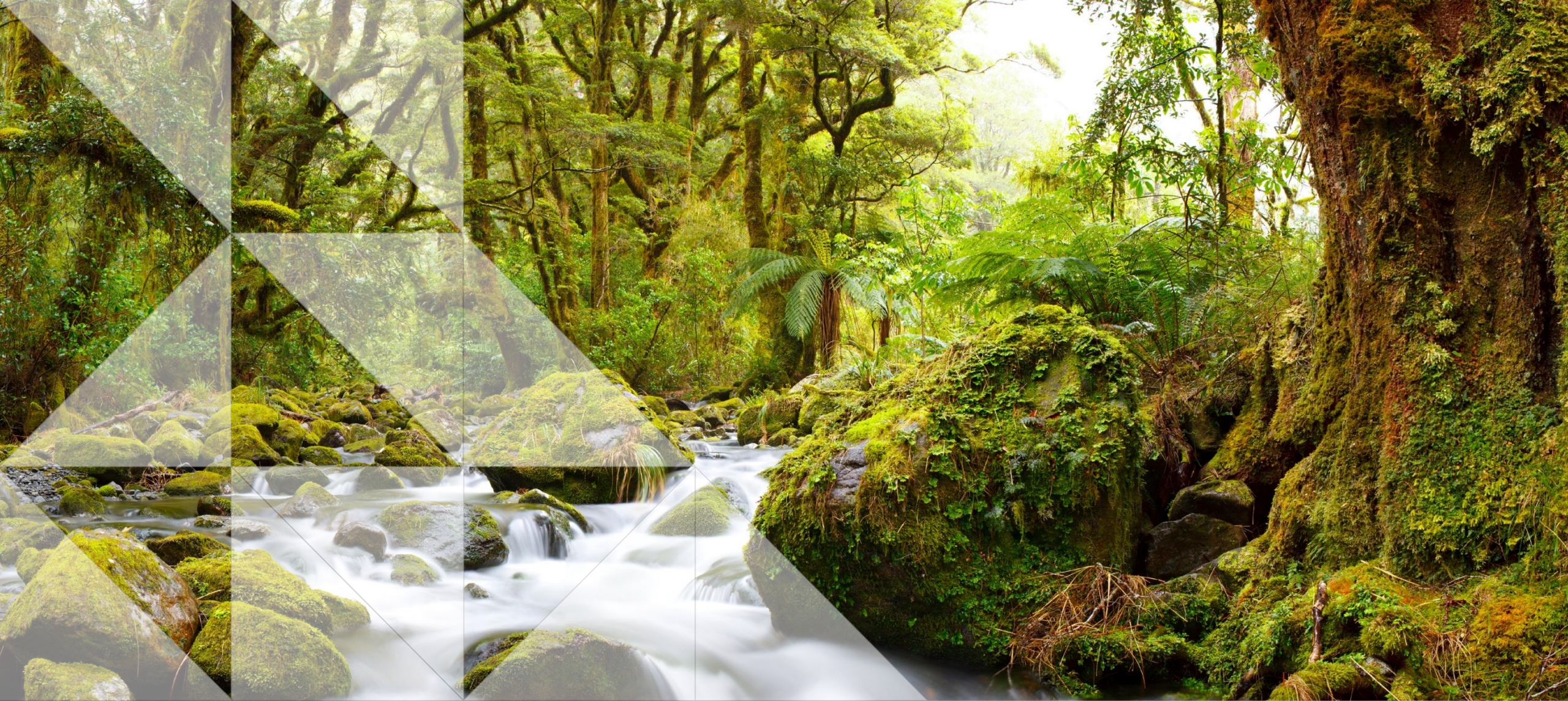
[www.branz.co.nz/calculators-tools/](http://www.branz.co.nz/calculators-tools/)





CO<sub>2</sub>RE demo





# Material quantities development



# Estimating for carbon – where science meets pragmatism

## Background/context

(Informative but not “must know” except **we can't estimate the whole from these bits!**)

- The HIG context
- Methodology and boundaries
- Key data sources
- Assumptions, approximations, reliability
- Waste, temporary works, P&G

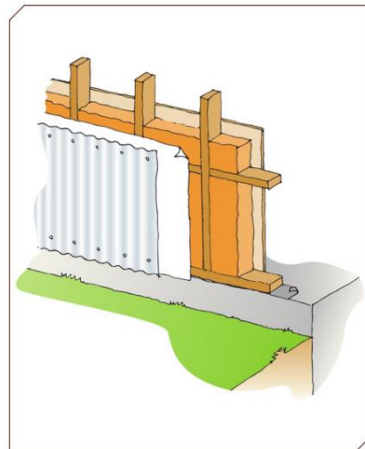


# House insulation guide – context

- Thermal envelope  $\neq$  carbon content – e.g. fibre cement sheet  $\neq$  plywood for carbon, lots of “non-thermal” items (eaves, internal walls)
- “The science and the practicality”
  - How much detail? How accurately?
  - Framing ratio – theory vs practice: 14% or  $>>20\%$ ?



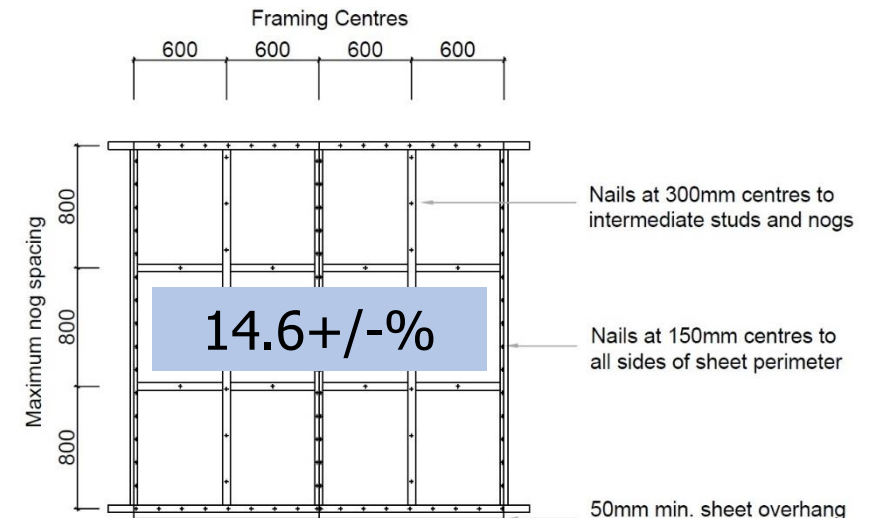
ELEMENT	CLADDING	CONSTRUCTION
Wall	Metal vertical profile	Timber-framed – direct-fixed 90 mm frame



Framing timber	Insulation material R-value					
	1.8	2.0	2.2	2.4	2.6	2.8
Construction R-value						
studs 600, cavangs 800 (14%)	1.6	1.7	1.8	1.9	2.0	2.1
studs 600, cavangs 600 (16%)	1.6	1.7	1.8	1.9	2.0	2.1
studs 400, cavangs 800 (18%)	1.6	1.7	1.7	1.8	1.9	2.0
studs 400, cavangs 600 (20%)	1.5	1.6	1.7	1.8	1.9	1.9
(22%) framing ratio	1.5	1.6	1.7	1.7	1.8	1.9
(24%) framing ratio	1.5	1.5	1.6	1.7	1.7	1.8

## Notes

1. All insulants should be placed against wall underlay
2. Under E2/AS1, vertical profiled metal cladding can be used without a cavity up to a risk score of 20
3. R3.0 is the highest practicable R-value of common insulation materials that can be used with 90 mm studs



SC003 Shadowclad Fastener Layout

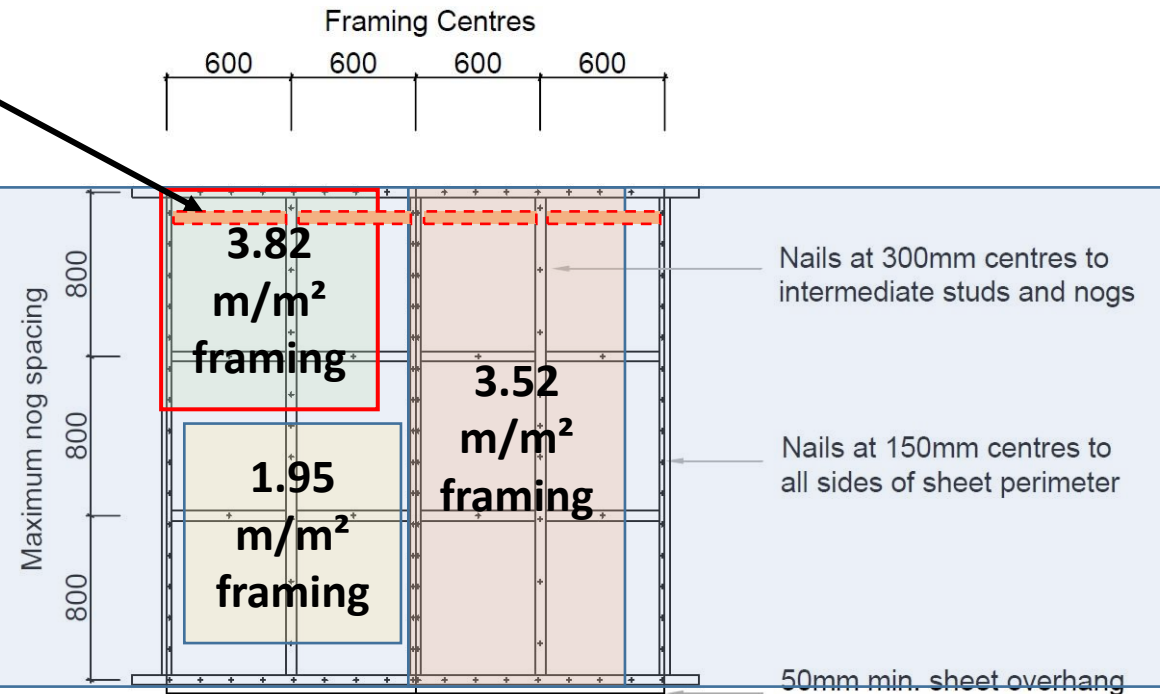
# Core methodology – very large ‘pure’ elements, junctions etc. as specials

Areas 10,000 m<sup>2</sup> (100 m x 100 m, floor, roof)

Lengths 1000 m (wall, corner, footing)

**1000 m long x 2.4 m high**  
**3.2 ± m/m<sup>2</sup>**

“Special”



SC003 Shadowclad Fastener Layout

# Boundaries and methodology

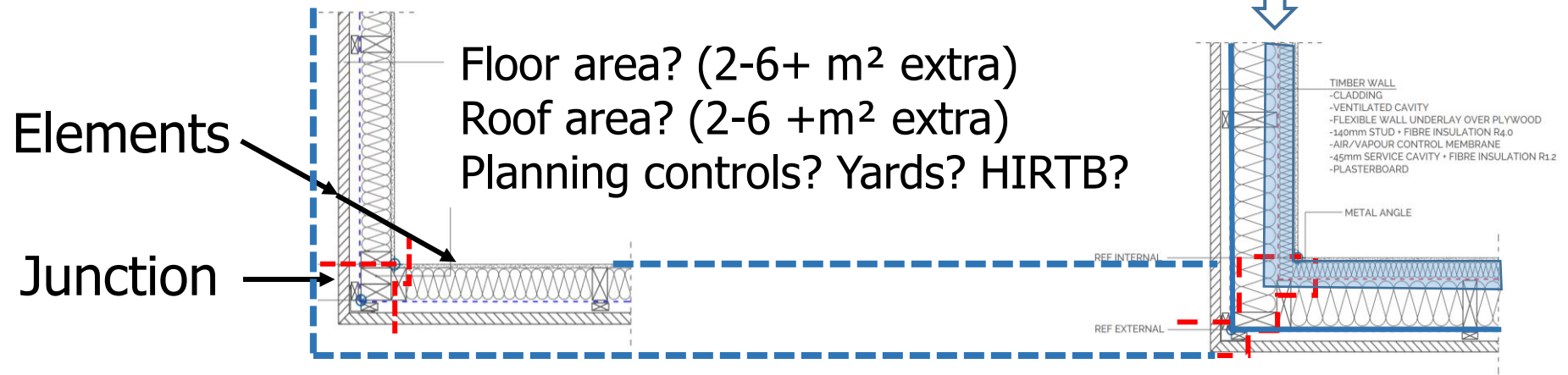
Life cycle assessment framework – “embodied”, “up front”, “whole of life embodied”, care with biogenic carbon

Update for MBIE’s technical methodology

Code compliance indicative only

Physical “boundaries”,

including concept of “**constant usable space**”

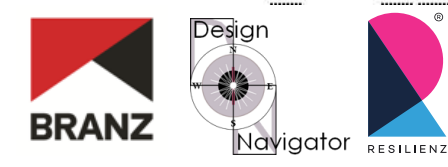


From guidance notes Resilienz > PHINZ/BRANZ



## Key data sources – not your typical house estimate

1801-91	1802-91	1803-91	1804-91	1805-91	1806-91	1807-91	1808-91	1809-91	1810-91	1811-91	1812-91	1813-91	1814-91	1815-91	1816-91	1817-91	1818-91	1819-91	1820-91	1821-91	1822-91	1823-91	1824-91	1825-91	1826-91	1827-91	1828-91	1829-91	1830-91	1831-91	1832-91	1833-91	1834-91	1835-91	1836-91	1837-91	1838-91	1839-91	1840-91	1841-91	1842-91	1843-91	1844-91	1845-91	1846-91	1847-91	1848-91	1849-91	1850-91	1851-91	1852-91	1853-91	1854-91	1855-91	1856-91	1857-91	1858-91	1859-91	1860-91	1861-91	1862-91	1863-91	1864-91	1865-91	1866-91	1867-91	1868-91	1869-91	1870-91	1871-91	1872-91	1873-91	1874-91	1875-91	1876-91	1877-91	1878-91	1879-91	1880-91	1881-91	1882-91	1883-91	1884-91	1885-91	1886-91	1887-91	1888-91	1889-91	1890-91	1891-91	1892-91	1893-91	1894-91	1895-91	1896-91	1897-91	1898-91	1899-91	1900-91	1901-91	1902-91	1903-91	1904-91	1905-91	1906-91	1907-91	1908-91	1909-91	1910-91	1911-91	1912-91	1913-91	1914-91	1915-91	1916-91	1917-91	1918-91	1919-91	1920-91	1921-91	1922-91	1923-91	1924-91	1925-91	1926-91	1927-91	1928-91	1929-91	1930-91	1931-91	1932-91	1933-91	1934-91	1935-91	1936-91	1937-91	1938-91	1939-91	1940-91	1941-91	1942-91	1943-91	1944-91	1945-91	1946-91	1947-91	1948-91	1949-91	1950-91	1951-91	1952-91	1953-91	1954-91	1955-91	1956-91	1957-91	1958-91	1959-91	1960-91	1961-91	1962-91	1963-91	1964-91	1965-91	1966-91	1967-91	1968-91	1969-91	1970-91	1971-91	1972-91	1973-91	1974-91	1975-91	1976-91	1977-91	1978-91	1979-91	1980-91	1981-91	1982-91	1983-91	1984-91	1985-91	1986-91	1987-91	1988-91	1989-91	1990-91	1991-91	1992-91	1993-91	1994-91	1995-91	1996-91	1997-91	1998-91	1999-91	2000-91	2001-91	2002-91	2003-91	2004-91	2005-91	2006-91	2007-91	2008-91	2009-91	2010-91	2011-91	2012-91	2013-91	2014-91	2015-91	2016-91	2017-91	2018-91	2019-91	2020-91	2021-91	2022-91	2023-91	2024-91	2025-91	2026-91	2027-91	2028-91	2029-91	2030-91	2031-91	2032-91	2033-91	2034-91	2035-91	2036-91	2037-91	2038-91	2039-91	2040-91	2041-91	2042-91	2043-91	2044-91	2045-91	2046-91	2047-91	2048-91	2049-91	2050-91	2051-91	2052-91	2053-91	2054-91	2055-91	2056-91	2057-91	2058-91	2059-91	2060-91	2061-91	2062-91	2063-91	2064-91	2065-91	2066-91	2067-91	2068-91	2069-91	2070-91	2071-91	2072-91	2073-91	2074-91	2075-91	2076-91	2077-91	2078-91	2079-91	2080-91	2081-91	2082-91	2083-91	2084-91	2085-91	2086-91	2087-91	2088-91	2089-91	2090-91	2091-91	2092-91	2093-91	2094-91	2095-91	2096-91	2097-91	2098-91	2099-91	2100-91	2101-91	2102-91	2103-91	2104-91	2105-91	2106-91	2107-91	2108-91	2109-91	2110-91	2111-91	2112-91	2113-91	2114-91	2115-91	2116-91	2117-91	2118-91	2119-91	2120-91	2121-91	2122-91	2123-91	2124-91	2125-91	2126-91	2127-91	2128-91	2129-91	2130-91	2131-91	2132-91	2133-91	2134-91	2135-91	2136-91	2137-91	2138-91	2139-91	2140-91	2141-91	2142-91	2143-91	2144-91	2145-91	2146-91	2147-91	2148-91	2149-91	2150-91	2151-91	2152-91	2153-91	2154-91	2155-91	2156-91	2157-91	2158-91	2159-91	2160-91	2161-91	2162-91	2163-91	2164-91	2165-91	2166-91	2167-91	2168-91	2169-91	2170-91	2171-91	2172-91	2173-91	2174-91	2175-91	2176-91	2177-91	2178-91	2179-91	2180-91	2181-91	2182-91	2183-91	2184-91	2185-91	2186-91	2187-91	2188-91	2189-91	2190-91	2191-91	2192-91	2193-91	2194-91	2195-91	2196-91	2197-91	2198-91	2199-91	2200-91	2201-91	2202-91	2203-91	2204-91	2205-91	2206-91	2207-91	2208-91	2209-91	2210-91	2211-91	2212-91	2213-91	2214-91	2215-91	2216-91	2217-91	2218-91	2219-91	2220-91	2221-91	2222-91	2223-91	2224-91	2225-91	2226-91	2227-91	2228-91	2229-91	2230-91	2231-91	2232-91	2233-91	2234-91	2235-91	2236-91	2237-91	2238-91	2239-91	2240-91	2241-91	2242-91	2243-91	2244-91	2245-91	2246-91	2247-91	2248-91	2249-91	2250-91	2251-91	2252-91	2253-91	2254-91	2255-91	2256-91	2257-91	2258-91	2259-91	2260-91	2261-91	2262-91	2263-91	2264-91	2265-91	2266-91	2267-91	2268-91	2269-91	2270-91	2271-91	2272-91	2273-91	2274-91	2275-91	2276-91	2277-91	2278-91	2279-91	2280-91	2281-91	2282-91	2283-91	2284-91	2285-91	2286-91	2287-91	2288-91	2289-91	2290-91	2291-91	2292-91	2293-91	2294-91	2295-91	2296-91	2297-91	2298-91	2299-91	2300-91	2301-91	2302-91	2303-91	2304-91	2305-91	2306-91	2307-91	2308-91	2309-91	2310-91	2311-91	2312-91	2313-91	2314-91	2315-91	2316-91	2317-91	2318-91	2319-91	2320-91	2321-91	2322-91	2323-91	2324-91	2325-91	2326-91	2327-91	2328-91	2329-91	2330-91	2331-91	2332-91	2333-91	2334-91	2335-91	2336-91	2337-91	2338-91	2339-91	2340-91	2341-91	2342-91	2343-91	2344-91	2345-91	2346-91	2347-91	2348-91	2349-91	2350-91	2351-91	2352-91	2353-91	2354-91	2355-91	2356-91	2357-91	2358-91	2359-91	2360-91	2361-91	2362-91	2363-91	2364-91	2365-91	2366-91	2367-91	2368-91	2369-91	2370-91	2371-91	2372-91	2373-91	2374-91	2375-91	2376-91	2377-91	2378-91	2379-91	2380-91	2381-91	2382-91	2383-91	2384-91	2385-91	2386-91	2387-91	2388-91	2389-91	2390-91	2391-91	2392-91	2393-91	2394-91	2395-91	2396-91	2397-91	2398-91	2399-91	2400-91	2401-91	2402-91	2403-91	2404-91	2405-91	2406-91	2407-91	2408-91	2409-91	2410-91	2411-91	2412-91	2413-91	2414-91	2415-91	2416-91	2417-91	2418-91	2419-91	2420-91	2421-91	2422-91	2423-91	2424-91	2425-91	2426-91	2427-91	2428-91	2429-91	2430-91	2431-91	2432-91	2433-91	2434-91	2435-91	2436-91	2437-91	2438-91	2439-91	2440-91	2441-91	2442-91	2443-91	2444-91	2445-91	2446-91	2447-91	2448-91	2449-91	2450-91	2451-91	2452-91	2453-91	2454-91	2455-91	2456-91	2457-91	2458-91	2459-91	2460-91	2461-91	2462-91	2463-91	2464-91	2465-91	2466-91	2467-91	2468-91	2469-91	2470-91	2471-91	2472-91	2473-91	2474-91	2475-91	2476-91	2477-91	2478-91	2479-91	2480-91	2481-91	2482-91	2483-91	2484-91	2485-91	2486-91	2487-91	2488-91	2489-91	2490-91	2491-91	2492-91	2493-91	2494-91	2495-91	2496-91	2497-91	2498-91	2499-91	2500-91	2501-91	2502-91	2503-91	2504-91	2505-91	2506-91	2507-91	2508-91	2509-91	2510-91	2511-91	2512-91	2513-91	2514-91	2515-91	2516-91	2517-91	2518-91	2519-91	2520-91	2521-91	2522-91	2523-91	2524-91	2525-91	2526-91	2527-91	2528-91	2529-91	2530-91	2531-91	2532-91	2533-91	2534-91	2535-91	2536-91	2537-91	2538-91	2539-91	2540-91	2541-91	2542-91	2543-91	2544-91	2545-91	2546-91	2547-91	2548-91	2549-91	2550-91	2551-91	2552-91	2553-91	2554-91	2555-91	2556-91	2557-91	2558-91	2559-91	2560-91	2561-91	2562-91	2563-91	2564-91	2565-91	2566-91	2567-91	2568-91	2569-91	2570-91	2571-91	2572-91	2573-91	2574-91	2575-91	2576-91	2577-91	2578-91	2579-91	2580-91	2581-91	2582-91	2583-91	2584-91	2585-91	2586-91	2587-91	2588-91	2589-91	2590-91	2591-91	2592-91	2593-91	2594-91	2595-91	2596-91	2597-91	2598-91	2599-91	2600-91	2601-91	2602-91	2603-91	2604-91	2605-91	2606-91	2607-91	2608-91	2609-91	2610-91	2611-91	2612-91	2613-91	2614-91	2615-91	2616-91	2617-91	2618-91	2619-91	2620-91	2621-91	2622-91	2623-91	2624-91	2625-91	2626-91	2627-91	2628-91	2629-91	2630-91	2631-91	2632-91	2633-91	2634-91	2635-91	2636-91	2637-91	2638-91	2639-91	2640-91	2641-91	2642-91	2643-91	2644-91	2645-91	2646-91	2647-91	2648-91	2649-91	2650-91	2651-91	2652-91	2653-91	2654-91	2655-91	2656-91	2657-91	2658-91	2659-91	2660-91	2661-91	2662-91	2663-91	2664-91	2665-91	2666-91	2667-91	2668-91	2669-91	2670-91	2671-91	2672-91	2673-91	2674-91	2675-91	2676-91	2677-91	2678-91	2679-91	2680-91	2681-91	2682-91	2683-91	2684-91	2685-91	2686-91	2687-91	2688-91	2689-91	2690-91	2691-91	2692-91	2693-91	2694-91	2695-91	2696-91	2697-91	2698-91	2699-91	2700-91	2701-91	2702-91	2703-91	2704-91	2705-91	2706-91	2707-91	2708-91	2709-91	2710-91	2711-91	2712-91	2713-91	2714-91	2715-91	2716-91	2717-91	2718-91	2719-91	2720-91	2721-91	2722-91	2723-91	2724-91	2725-91	2726-91	2727-91	2728-91	2729-91	2730-91	2731-91	2732-91	2733-91	2734-91	2735-91	2736-91	2737-91	2738-91	2739-91	2740-91	2741-91	2742-91	2743-91	2744-91	2745-91	2746-91	2747-91	2748-91	2749-91	2750-91	2751-91	2752-91	2753-91	2754-91	2755-91	2756-91	2757-91	2758-91	2759-91	2760-91	2761-91	2762-91	2763-91	2764-91	2765-91	2766-91	2767-91	2768-91	2769-91	2770-91	2771-91	2772-91	2773-91	2774-91	2775-91	2776-91	2777-91	2778-91	2779-91	2780-91	2781-91	2782-91	2783-91	2784-91	2785-91	2786-91	2787-91	2788-91	2789-91	2790-91	2791-91	2792-91	2793-91	2794-91	2795-91	2796-91	2797-91	2798-91	2799-91	2800-91	2801-91	2802-91	2803-91	2804-91	2805-91	2806-91	2807-91	2808-91	2809-91	2810-91	2811-91	2812-91	2813-91	2814-91	2815-91	2816-91	2817-91	2818-91	2819-91	2820-91	2821-91	2822-91	2823-91	2824-91	2825-91	2826-91	2827-91	2828-91	2829-91	2830-91	2831-91	2832-9
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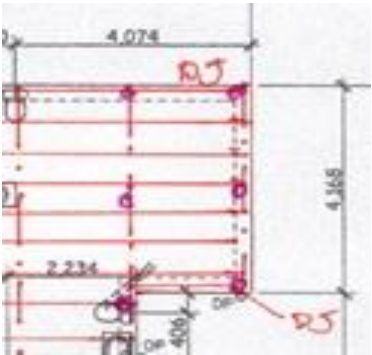


# Assumptions, approximations, reliability - examples

- *Relatively* efficient construction, but ignore, say:
  - Bearers/piles under end spans vs mid spans
  - “**MEMBER SPAN**. The clear distance between supports” **TIP!**
- Breakdown of components to estimate mass/carbon
- **Fixings** – very variable, hard to measure



*Sto cladding system:  
Priced all together,  
Carbon separately (unless EPD)*



Subfloor markup

DESCRIPTION	QTY	UNIT	Inc waste	kg/m3 DENSITY	kg MASS	10000.000 MASS/M2
70 x 45 Rad MSG8 H1.2 MG KD RL wet	12941.1	LM	0.125	550	22420.456	2.242
Purlin screws - box of 250	59	Boxes	0.025	2.250	132.750	0.013

## Waste, temporary works and P&G

- LCA waste and construction waste not the same
- Packaging: 12% of house building waste – excluded
- P&G and temporary works – only formwork

Approximate Formwork allowance	
Indicative formwork based on a reuse of	50.00%
240 x 17 black faced ply two faces	500
90 x 45 Rad MSG6 H1.2 MG RL to rebate	210
90 x 20 Rad boxing grade to inside face	210
45 x 45 Rad MSG6 H5 MG RL to pack slab edge	0
45 x 45 Rad MSG6 H1.2 MG all supports @ 600 cs	1600
Notional 6 nails/screws/m Zn coated steel	15120

## To quickly recap

- “Boundaries” important and bits don’t add up to a whole
- Good thermal design may not equal good carbon design
- Sweat the detail (and codes) for cost and carbon savings
- Factor in “constant usable space” when comparing options
- Vast background data (sometimes tricky to reconcile)

Thank you!