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[1.0]

Solution.

THINK · TALK · CREATE CARBON TOOLS WEBINAR SERIES

Upcoming webinars

Webinar 2 Wednesday 18 May 12–1pm

- CO_2RE

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

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Previously

Carbon Challenge – Science and Solutions webinars (March 2022)

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

www.branz.co.nz/pubs/previous-webinars/

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About us

Dave Dowdell, BRANZ

Nick Carman, Mott MacDonald

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Building Research Levy

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Questions

Please feel free to ask questions by using the Chat feature

We will take questions at the end of the webinar

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Programme

- Background to LCAPlay
- LCAPlay demonstration
- Q&A

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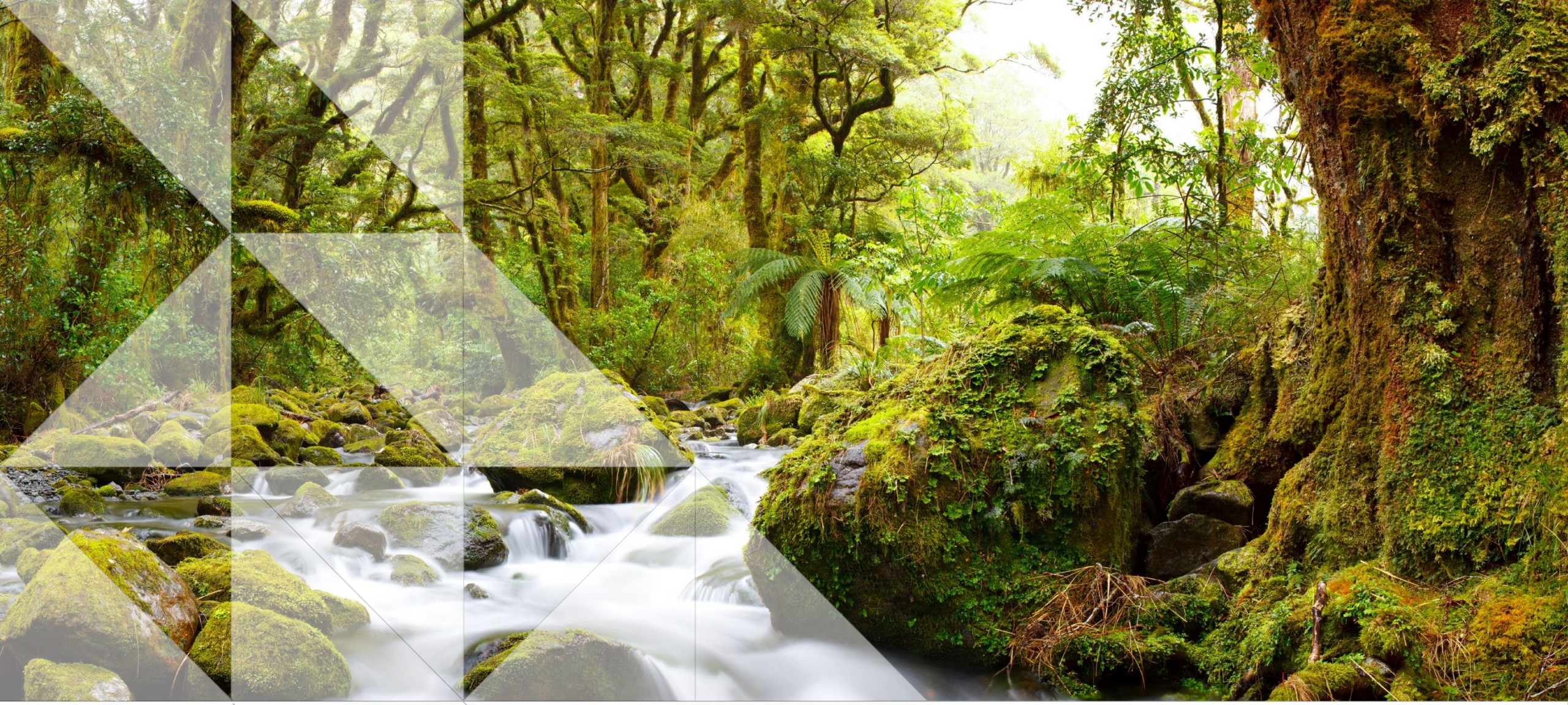

LCAPlay

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Background to LCAPlay

Why the need for LCAPlay?

Early design decisions can lock in significant future environmental impacts

A tool to facilitate comparison of commercial building early design options

Quick, intuitive, easy to use

Provides estimate of climate change impact (and other environmental indicators)

Results include potential embodied and operational impacts

Precedes LCAQuick [Webinar 5 Wednesday 8 June 12–1 pm]

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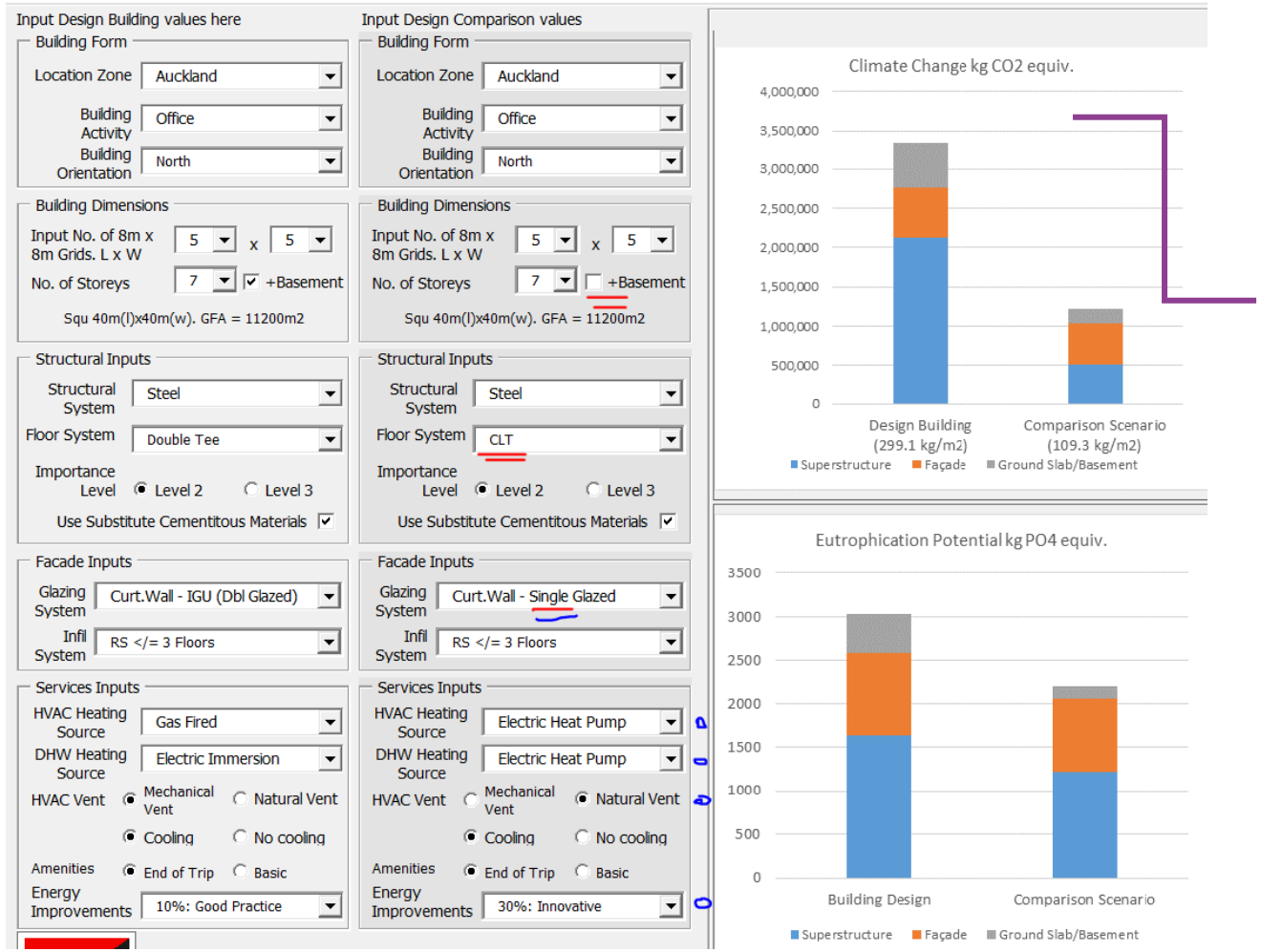
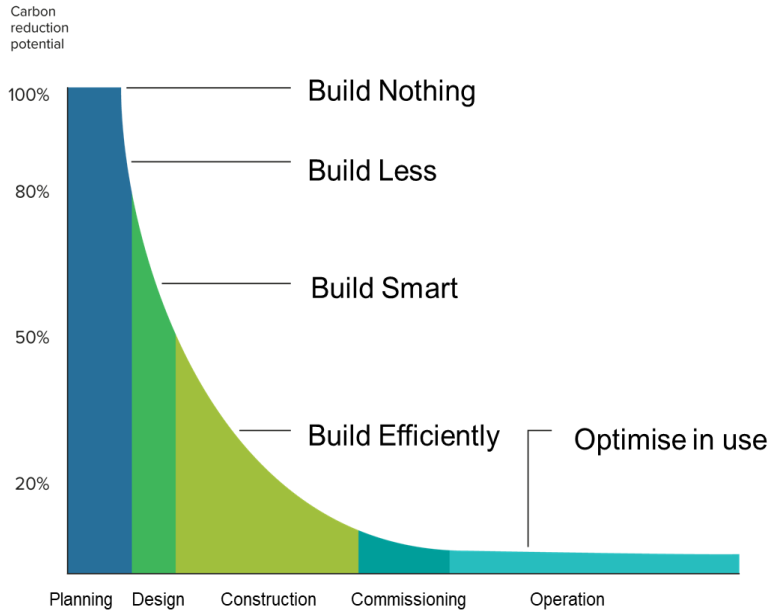
LCAPlay: Free commercial building tool (NZ)

Aim: Whole of life embodied + operational – summary values for scheme comparisons





PAS2080 curve:
Early metrics on carbon are crucial

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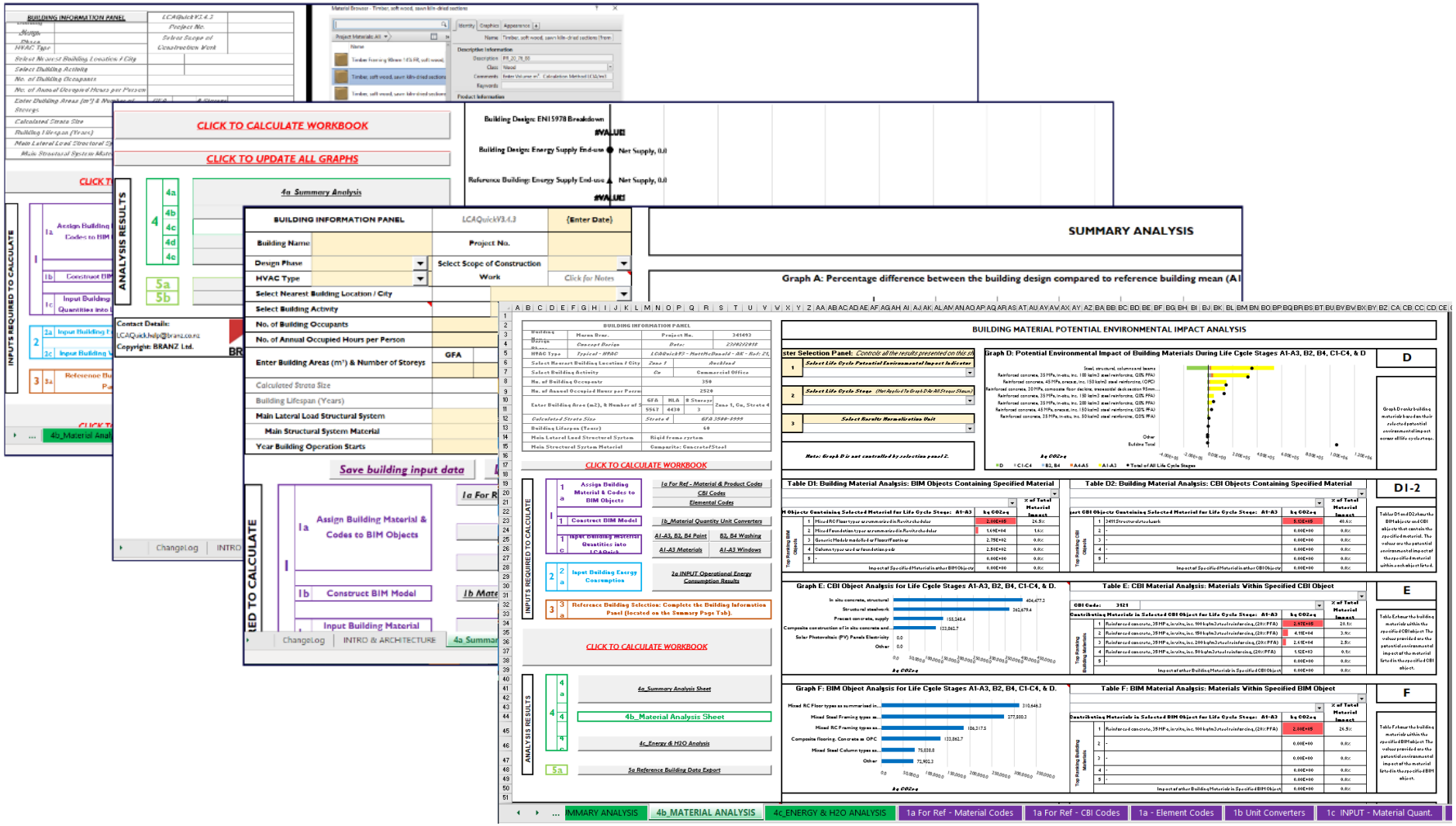
Background

Current tool – LCAQuick



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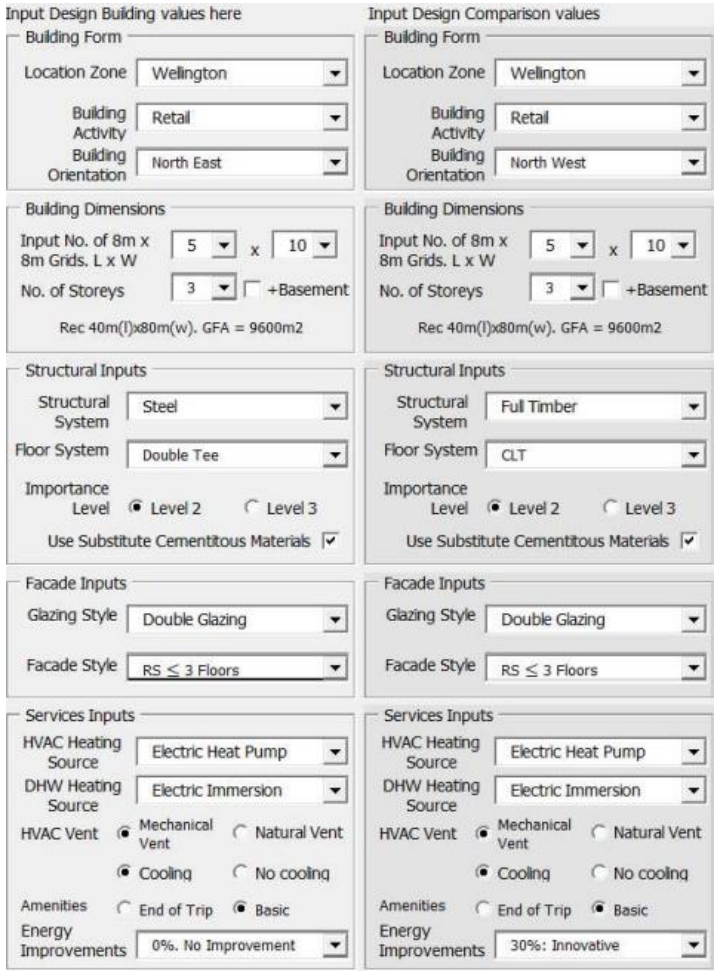
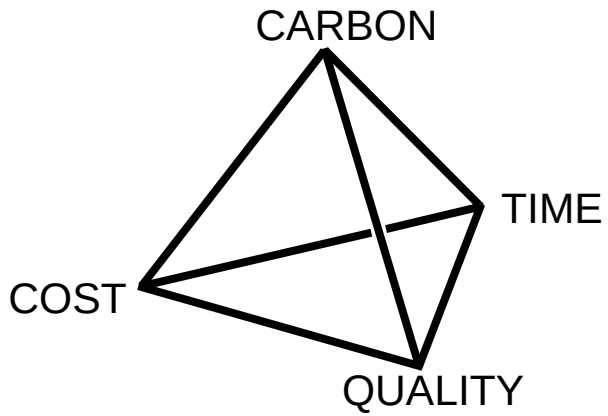
Aim of LCAPlay

To play!





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Straight into an initial demo to demonstrate speed …

LCAQuick

- Material quantities required
- Later stages of design or once built
- Detailed approach with high level of input

OUTPUT

The LCA impacts of your building design

LCAPlay

- Predefined scenarios (1000s & 1000s)
- High-level concept design options
- Indicative numbers for scheme comparison

OUTPUT

What the LCA impacts of your building design could be

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LCAQuick

- Material quantities required
- Later stages of design or once built
- Detailed approach with high level of input

LCAPlay

- Predefined scenarios (1000s & 1000s)
- High-level concept design options
- Indicative numbers for scheme comparison

What the LCA impacts of your building design could be

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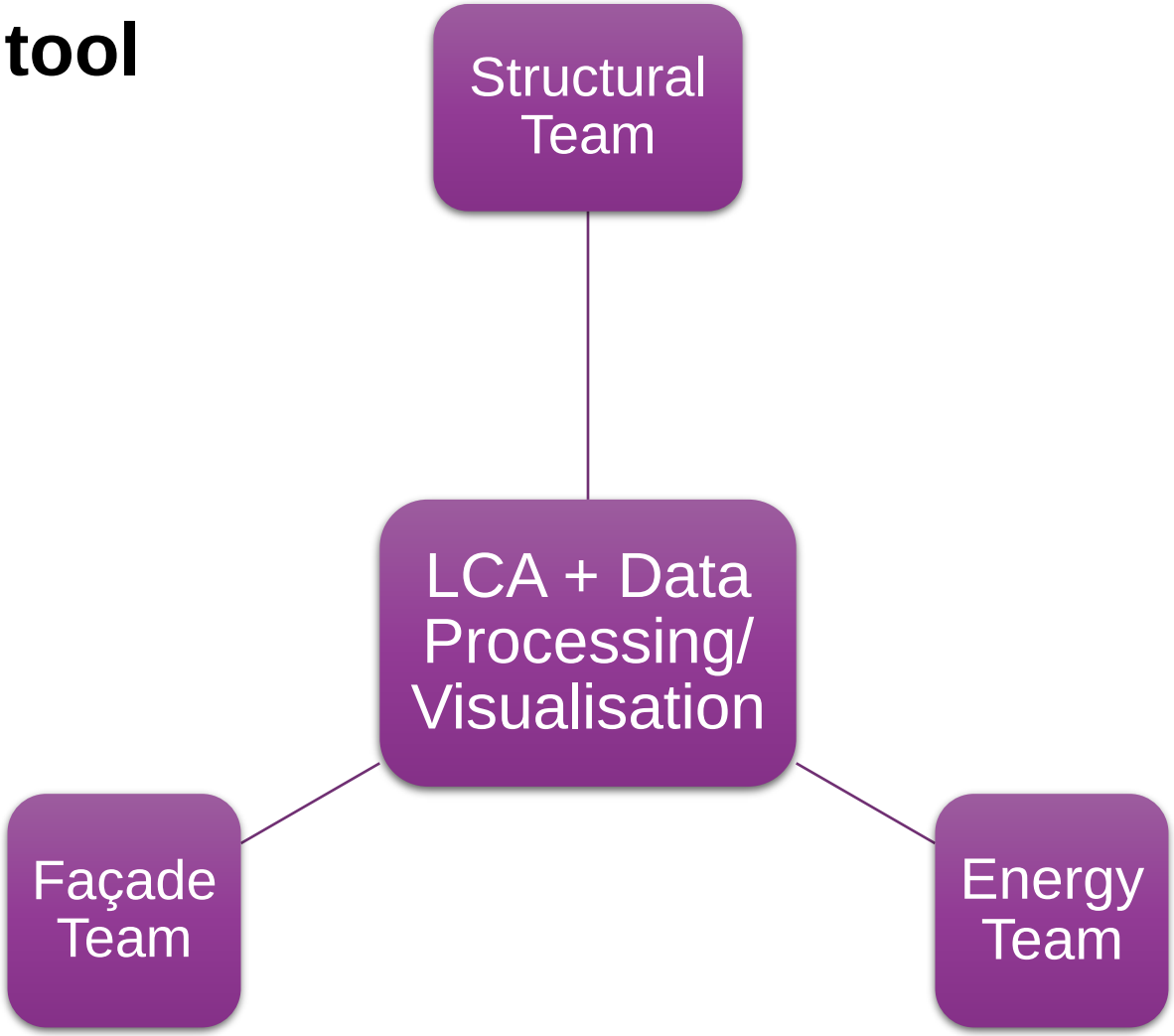
Development of tool



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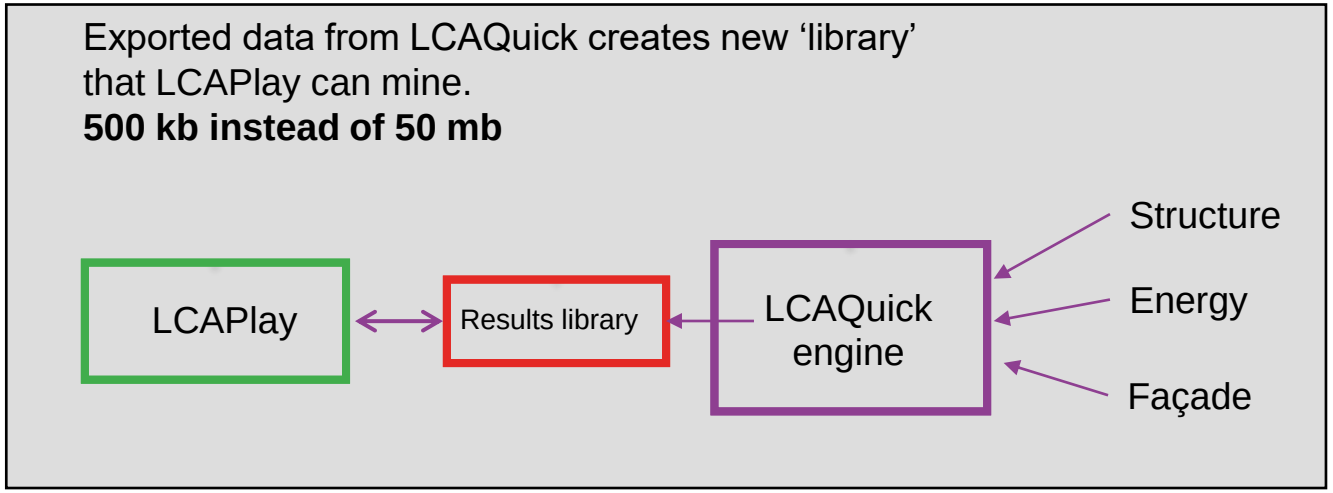
Development of tool

Excel and VBA



Locations: Auckland, Wellington, Christchurch
Functions: Office, hotel, retail
Heights: 1–20 storeys (& basement Y/N)
Orientations: 8 compass points
Building shape: Square or rectangular
Basic building structure, façade, services systems
But NO FOUNDATIONS or FITOUT and no refrigerant losses

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Development of tool

Façade analysis

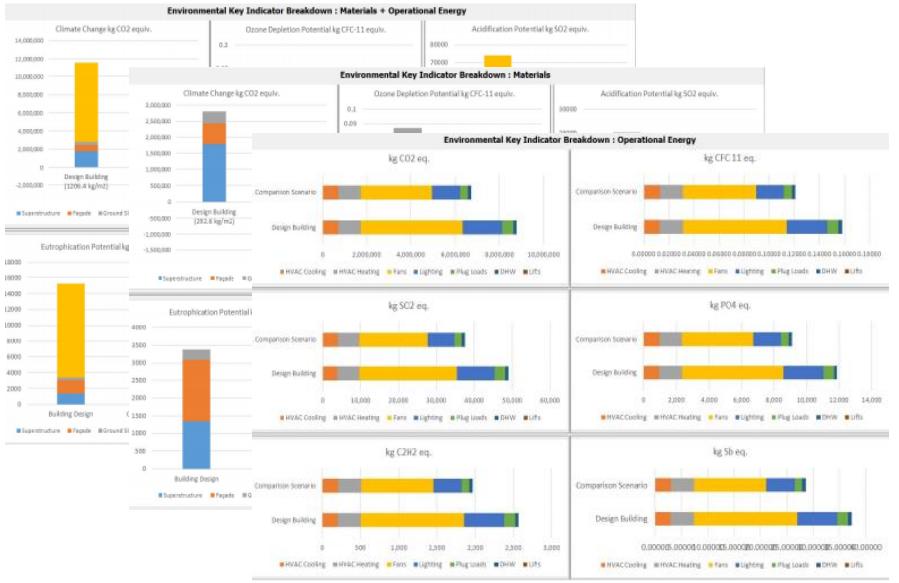
Strategy

- **Simple façade types chosen deliberately**
- **Basic 50% WWR**
- **Calculated each façade type $kgCO_2eq/m^2$ in LCAQuick**
- **Multiply these values by façade area obtained by building geometry inputs**

Verification

- **Able to quickly validate total $kgCO_2eq$ numbers produced by LCA concept tool by checking the same geometry and materials in LCAQuick**

LCAPlay



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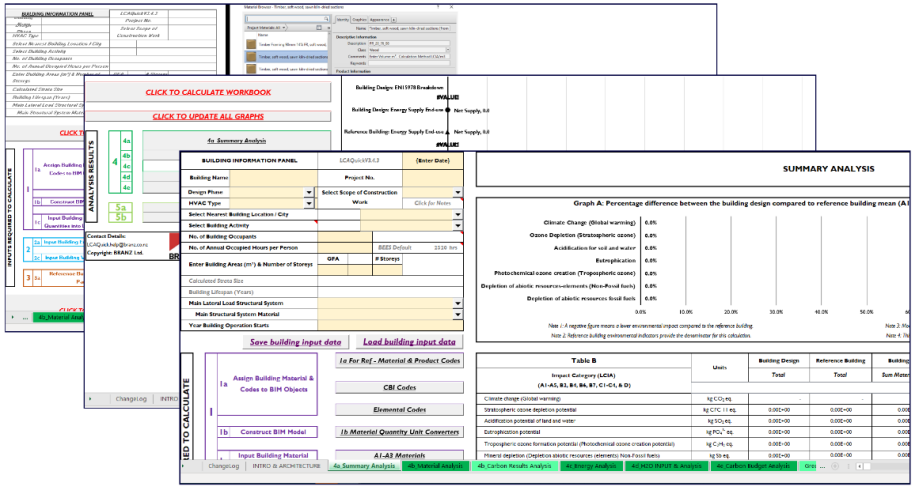
LCAQuick



Development of tool

Façade types in rev 1.0

Building information

- **Location** – relevant for purlin design only in this study
- **Number of storeys** – façade area and lightweight façade options
- **Building shape** – façade area

Façade systems

- **Heavyweight façade**
  1–20 storeys: 50% glazed curtain wall system, 50% **precast concrete panels**

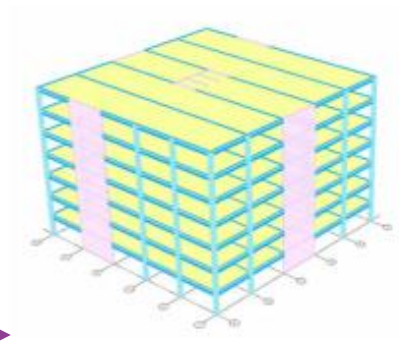
- **Lightweight façade**
  1–3 storeys: 50% glazed curtain wall system, 50% proprietary **aluminium cladding panels** over cavity and studs
  4–20 storeys: 50% glazed curtain wall system, 50% specific engineering design ‘hook-on’ **aluminium cladding panels**

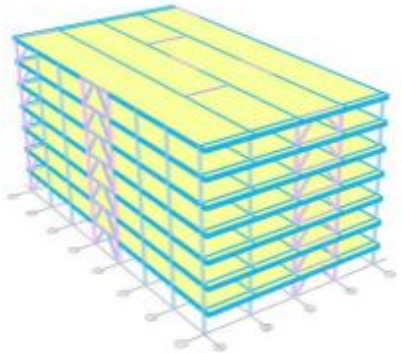
  Single or double-glazed (IGU) curtain wall systems can be selected for any building type

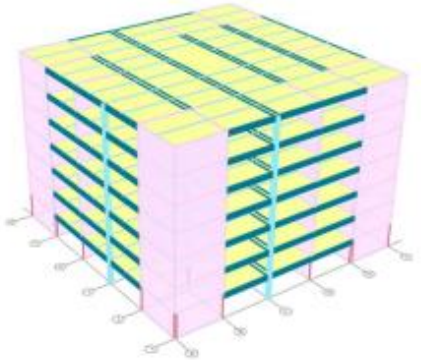
- **Roof to all buildings**
  Profiled metal roof with insulation and steel purlins based off typical details from New Zealand suppliers

Development of tool

Structural perspective







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Development of tool

Structural types in rev 1.0

Building information

- **Location and importance level** – relevant for determining approximate seismic loads (site soil class C assumed for all)
- **Number of storeys and building shape** – but with grids fixed at 8 m and f-2-f fixed at 4 m and LL=3.0kPa for all
- **Single basement** Y/N, **use of SCMs** Y/N

Structural systems

- **Reinforced concrete primary structure**
  1–20 storeys: RC gravity beams and columns, RC shear walls

- **Steel primary structure**
  1–20 storeys: steel gravity beams and columns, steel chevron braces (EBFs)

- **Engineered timber primary structure**
  1–7 storeys: either full glulam gravity beams and columns and CLT shear walls (with steel hold-downs to ends)
  or glulam columns and steel beams, and CLT shear walls (with steel hold-downs to ends)

- **Floor systems**
  Either standard 250 double-tees or 150 thick CLT with additional steel beams at 4 m mid-span

Foundations not Included as always bespoke to the site/soil and the building
Note that the #s are summed A–D values and include biogenic carbon storage values

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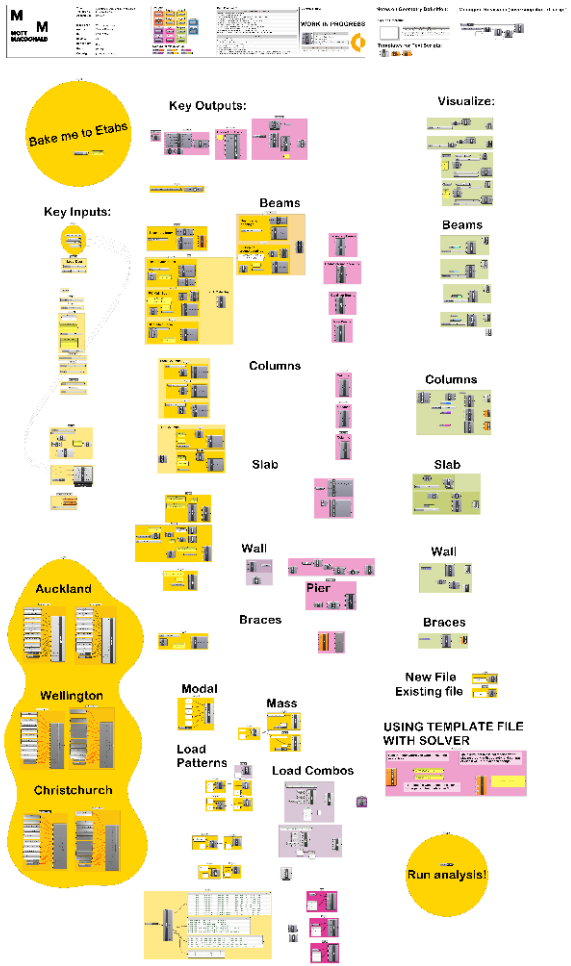
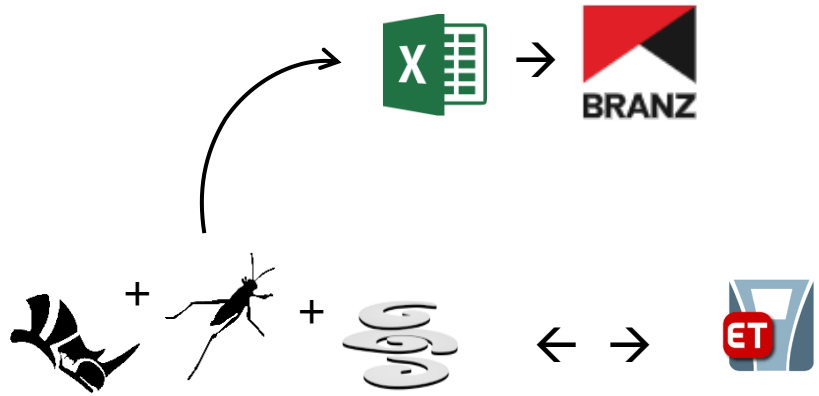
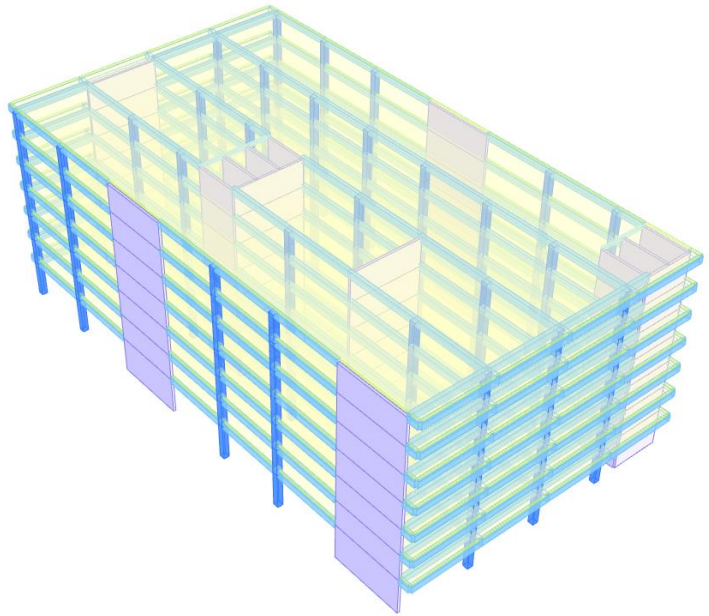
Development of tool

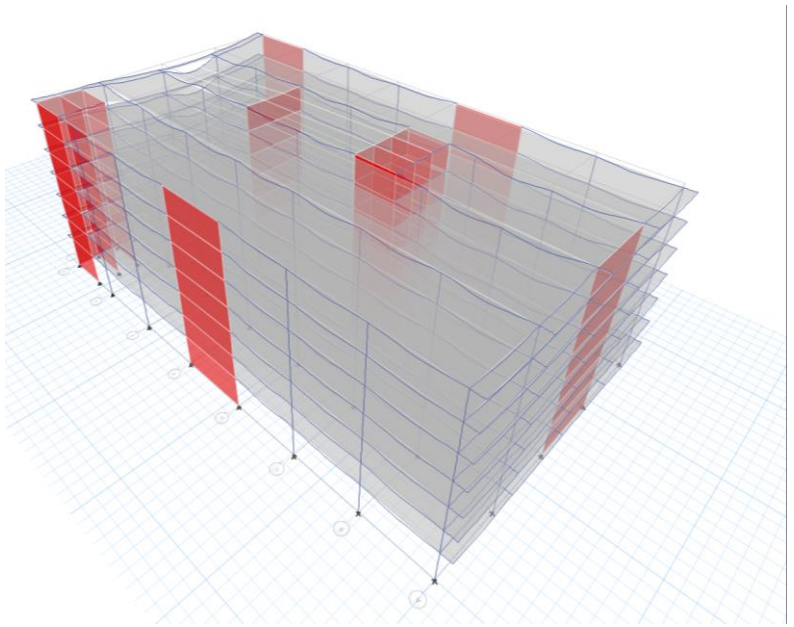
Digital processes







Rhino



ETABS

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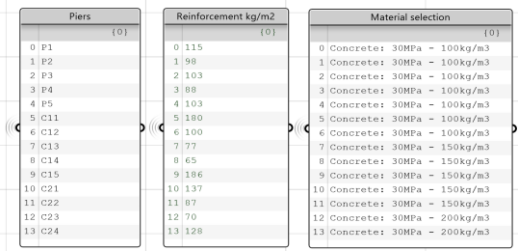
Development of tool

Structural engineering model and checking

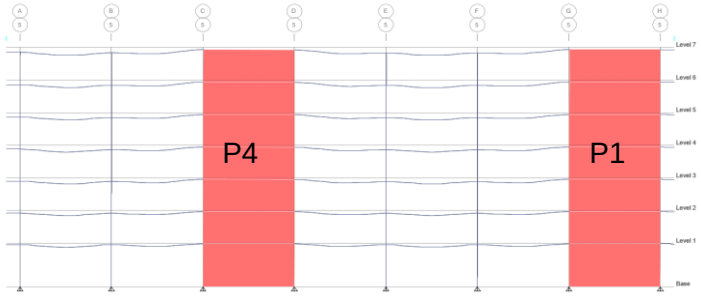
- Model
  - Project
  - Structure Layout
    - Stories
    - Grids
  - Properties
  - Structural Objects
  - Groups
  - Loads
    - Functions
    - Load Patterns
      - Dead
      - Facade - Lightweight
      - Facade - Precast
      - Live
      - SDL
      - STAT X Auckland
      - STAT X Christchurch
      - STAT X Wellington
      - STAT Y Auckland
      - STAT Y Christchurch
      - STAT Y Wellington
    - Shell Uniform Load Sets
    - Mass Sources
      - MsSrc1
    - Modal Cases
      - Modal
    - Load Cases
      - Dead
      - Live
      - SDL
      - STAT X Auckland
      - Facade - Lightweight
      - STAT Y Auckland
      - Facade - Precast
    - Load Combos
      - 1.0G + 0.3Q + 100%Stat X+ 30% Stat Y
      - 1.0G + 0.3Q + 100%Stat Y+ 30% Stat X
    - Walking Vibrations
  - Named Output Items
    - Section Cuts
    - Pier Labels
      - C11
      - C12
      - C13
      - C14
      - C15
      - C21
      - C22
      - C23
      - C24
      - P1
      - P2
      - P3
      - P4

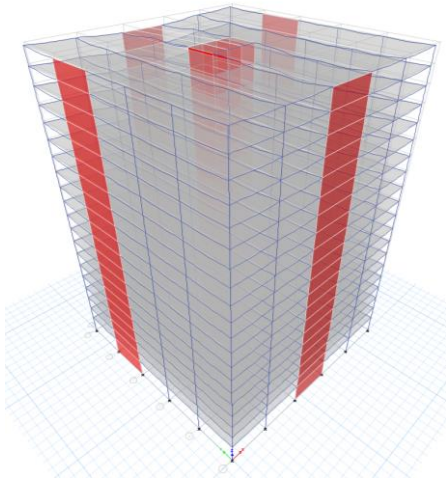


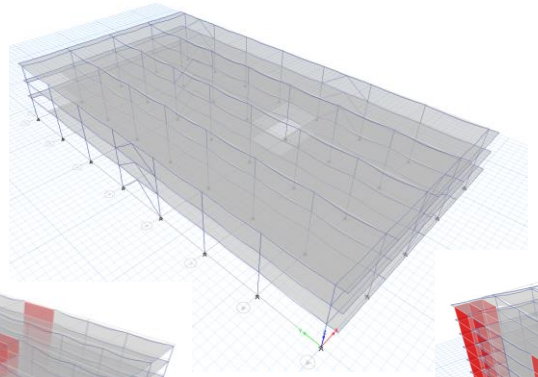
	Piers
0	P1
1	P2
2	P3
3	P4
4	P5
5	C11
6	C12
7	C13
8	C14
9	C15
10	C21
11	C22
12	C23
13	C24

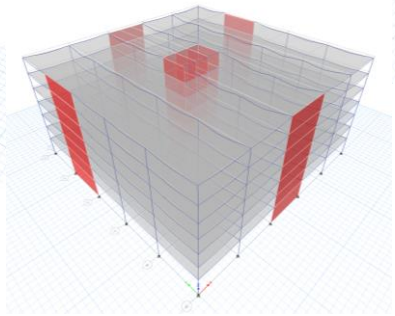
	Reinforcement kg/m2
0	115
1	98
2	103
3	88
4	103
5	180
6	100
7	77
8	65
9	186
10	137
11	87
12	70
13	128

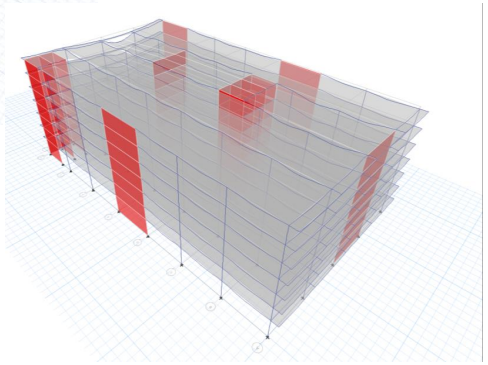
	Material selection
0	Concrete: 30MPa - 100kg/m3
1	Concrete: 30MPa - 100kg/m3
2	Concrete: 30MPa - 100kg/m3
3	Concrete: 30MPa - 100kg/m3
4	Concrete: 30MPa - 100kg/m3
5	Concrete: 30MPa - 100kg/m3
6	Concrete: 30MPa - 100kg/m3
7	Concrete: 30MPa - 150kg/m3
8	Concrete: 30MPa - 150kg/m3
9	Concrete: 30MPa - 150kg/m3
10	Concrete: 30MPa - 150kg/m3
11	Concrete: 30MPa - 150kg/m3
12	Concrete: 30MPa - 200kg/m3
13	Concrete: 30MPa - 200kg/m3

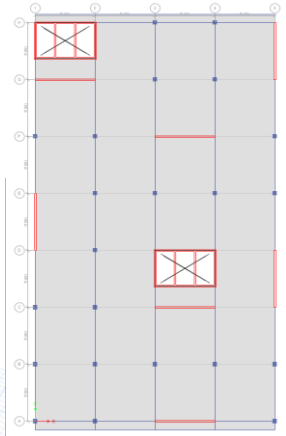












Development of tool

Digital processes

BUILDING INFORMATION PANEL				LCAQuickV3.4.2		13-Aug-20
Building Name	40 Bowen Street			Project No.		403776
Design Phase	Concept Design			Select Scope of Construction Work		Structure Only
HVAC Type	Typical - HVAC					Click for Notes
Select Nearest Building Location / City				Zone 1	Auckland	
Select Building Activity				Co	Commercial Office	
No. of Building Occupants						
No. of Annual Occupied Hours per Person					BEES Default	2520 hrs
Enter Building Areas (m²) & Number of Storeys	GFA	NLA	# Storeys	Structure Only, Zone 1, Co, Strata 5		
	14,573		7			
Calculated Strata Size				Strata 5	GFA >9000	
Building Lifespan (Years)				60		
Main Lateral Load Structural System				Braced Frame and Shear-walled frame systems		
Main Structural System Material				Reinforced Concrete		
Year Building Operation Starts				2020		

Save building input data | Load building input data

CLICK TO CALCULATE WORKBOOK

CLICK TO UPDATE ALL GRAPHS

ANALYSIS RESULTS

4 4a 4b 4c 4d 4e

- 4a_Summary Analysis
- 4b_Building Material Analysis
- 4c_Building Energy (B6) Analysis
- 4d_Building H2O (B7) Analysis
- 4e_Carbon Budget Analysis

5a 5b

- 5a_Reference Building Data Export
- 5b_Reference Building Data Import

Contact Details:
LCAQuick.help@branz.co.nz

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ecoinvent http://www.ecoinvent.org/

Exported data

	A	J	N	O	S	U	V	W	X	AF
1	No	Number of Storeys	Structural System	Floor System	Zone	BIM Object Type	BIM Object Name	LCAQuick Material Code	LCAQuick Material Name/Description	Material Volume (m3)
2	1	1	Steel	CLT	Auckland	Columns	400WC-144(400WC181*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	1.48
3	1	1	Steel	CLT	Auckland	Columns	100x100x5.0(SHS)()	PR_20_76_51_12_1_5_8_3_1	100x100x5.0, Square Hollow Section (SHS), steel (pri	0.95
4	1	1	Steel	CLT	Auckland	Secondary Beams	410UB-59.7()	PR_20_76_51_12_1_1_10_1_1	610UB-101.0, steel (primary), factory painted	2.88
5	1	1	Steel	CLT	Auckland	Main Beams	610UB-101.0()	PR_20_76_51_12_1_1_10_1_1	610UB-101.0, steel (primary), factory painted	4.93
6	1	1	Steel	CLT	Auckland	Collector Beams	310UC-96.8(310UC96.9*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	0.07
7	1	1	Steel	CLT	Auckland	Active Links	250UC-89.5(250UC89.6*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	0.31
8	1	1	Steel	CLT	Auckland	Active Links	250UC-89.5(250UC89.5*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	0.31
9	1	1	Steel	CLT	Auckland	Collector Beams	310UC-96.8(310UC96.8*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	0.07
10	1	1	Steel	CLT	Auckland	Braces	250UC-72.9(250UC72.9*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	0.78
11	2	1	Steel	CLT	Wellington	Braces	310UC-96.8(310UC96.8*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	0.52
12	2	1	Steel	CLT	Wellington	Collector Beams	310UC-158.0(310UC158*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	0.12
13	2	1	Steel	CLT	Wellington	Active Links and Braces	310UC-118.0(310UC118*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	1.02
14	2	1	Steel	CLT	Wellington	Active Links and Collector Beams	310UC-137.0(310UC137*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	0.57
15	2	1	Steel	CLT	Wellington	Columns	100x100x5.0(SHS)()	PR_20_76_51_12_1_5_8_3_1	100x100x5.0, Square Hollow Section (SHS), steel (pri	0.95
16	2	1	Steel	CLT	Wellington	Main Beams	610UB-101.0()	PR_20_76_51_12_1_1_10_1_1	610UB-101.0, steel (primary), factory painted	4.93
17	2	1	Steel	CLT	Wellington	Secondary Beams	410UB-59.7()	PR_20_76_51_12_1_1_10_1_1	610UB-101.0, steel (primary), factory painted	2.88
18	2	1	Steel	CLT	Wellington	Columns	400WC-144(400WC212 - G300*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	0.87
19	2	1	Steel	CLT	Wellington	Columns	400WC-144(400WC270 - G300*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	1.11
20	3	1	Steel	CLT	Christchurch	Columns	400WC-144(400WC270 - G300*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	2.21
21	3	1	Steel	CLT	Christchurch	Main Beams	610UB-101.0()	PR_20_76_51_12_1_1_10_1_1	610UB-101.0, steel (primary), factory painted	4.93
22	3	1	Steel	CLT	Christchurch	Secondary Beams	410UB-59.7()	PR_20_76_51_12_1_1_10_1_1	610UB-101.0, steel (primary), factory painted	2.88
23	3	1	Steel	CLT	Christchurch	Columns	100x100x5.0(SHS)()	PR_20_76_51_12_1_5_8_3_1	100x100x5.0, Square Hollow Section (SHS), steel (pri	0.95
24	3	1	Steel	CLT	Christchurch	Active Links	310UC-137.0(310UC137*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	0.93
25	3	1	Steel	CLT	Christchurch	Braces	310UC-118.0(310UC118*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	1.25
26	3	1	Steel	CLT	Christchurch	Collector Beams	310UC-158.0(310UC158*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	0.23
27	4	1	Steel	CLT	Auckland					
28	4	1	Steel	CLT	Auckland	Columns	100x100x5.0(SHS)()	PR_20_76_51_12_1_5_8_3_1	100x100x5.0, Square Hollow Section (SHS), steel (pri	0.95
29	4	1	Steel	CLT	Auckland	Secondary Beams	410UB-59.7()	PR_20_76_51_12_1_1_10_1_1	610UB-101.0, steel (primary), factory painted	2.51
30	4	1	Steel	CLT	Auckland	Main Beams	610UB-101.0()	PR_20_76_51_12_1_1_10_1_1	610UB-101.0, steel (primary), factory painted	3.54
31	4	1	Steel	CLT	Auckland	Collector Beams	310UC-96.8(310UC96.9*1)	PR_20_76_51_12_1_2_5_4_1	310UC-158.0, steel (primary), factory painted	0.07

BUILDING MATERIAL QUANTITIES

INSTRUCTIONS:

Enter the building material quantities that make-up the final built form. This excludes construction waste, maintenance, replacement, as these are automatically calculated.

Ensure every building material in each BIM object or construction system is listed, and they have a LCAQuick material code, name/descritpion, a unit quantitiy description and corresponding quantity. The cells in columns AL-AQ are checks to ensure these requirements are fulfilled.

Ensure there are no blank cells, instead enter 0.

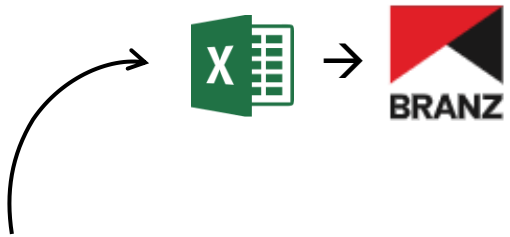
To reduce calculation time, it is advised to only paste in the sum of each unique BIM object or construction system. The Removing Duplicates sheet/tab can be used to find the sum of each unique BIM object or construction system. Unique BIM object / construction systems objects are defined by the combination of their Family, Type, CBI, Element, and Material Codes and Descriptions.

Note: Enter window, door, and louvre materials in sheet 1c INPUT - Window Material Quantities

Parameter 1: BIM Object Family or Construction Type e.g. Wall, roof, floor etc.	Parameter 2: BIM Object Type or Construction System Name	Parameter 3: LCAQuick Material Code	Parameter 4: LCAQuick Material Name/Description	Column being Summed: Count. Number of Items	Column being Summed: Material Surface Area (m2)	Column being Summed: Material Volume (m3)
Optional Input. If not used enter 0 so there are no blank cells	*Mandatory Input*	*Mandatory Input*	*Mandatory Input*	*Input dependent on material*	*Input dependent on material*	*Input dependent on material*
Main Beams	Concrete: 30MPa - 100kg/m3	PR_20_31_16_4_2_2_1	Reinforced concrete, 30 MPa, in-situ, inc. 100 kg/m3 steel reinforcing, (OPC)	434		720
Wall	Concrete: 30MPa - 100kg/m3	PR_20_31_16_4_2_2_1	Reinforced concrete, 30 MPa, in-situ, inc. 100 kg/m3 steel reinforcing, (OPC)	189	2816	684
Column	Concrete: 30MPa - 200kg/m3	PR_20_31_16_4_2_4_1	Reinforced concrete, 30 MPa, in-situ, inc. 200 kg/m3 steel reinforcing, (OPC)	154		174
Floor	Concrete Floor: 30MPa - 100kg/m3	PR_20_31_16_4_3_2_1	Reinforced concrete, 30 MPa, precast, inc. 100 kg/m3 steel reinforcing, (OPC)	266	12602	2268

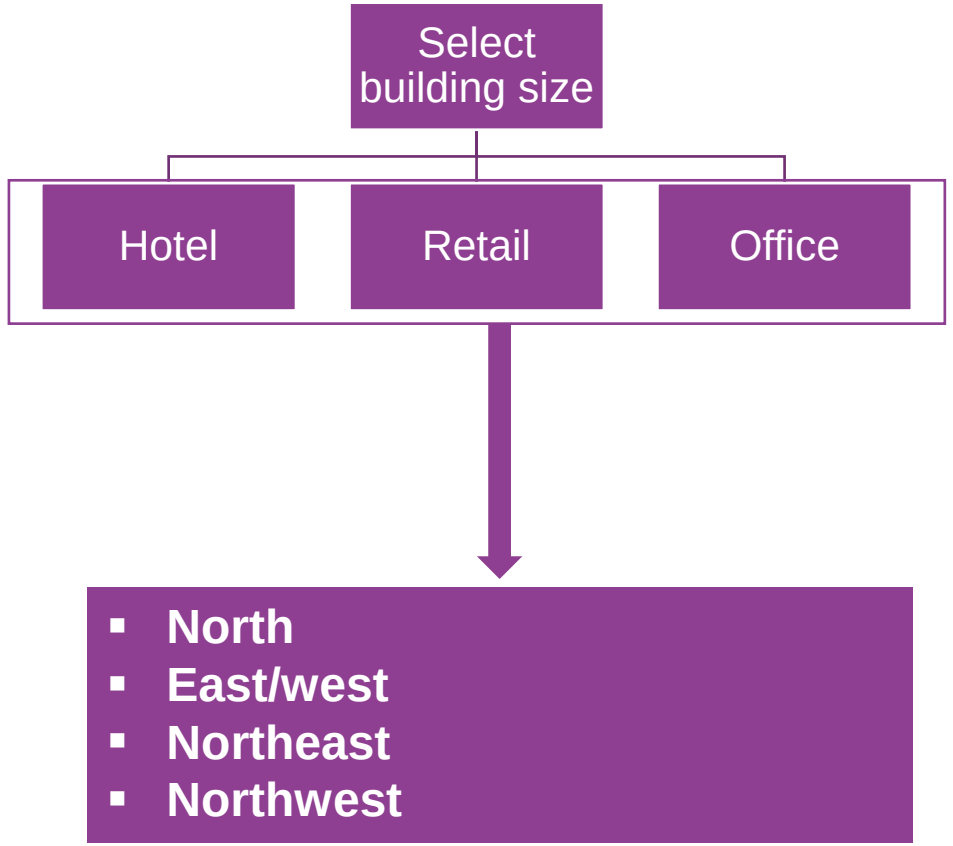
BRANZ MOTT MACDONALD

Energy analysis



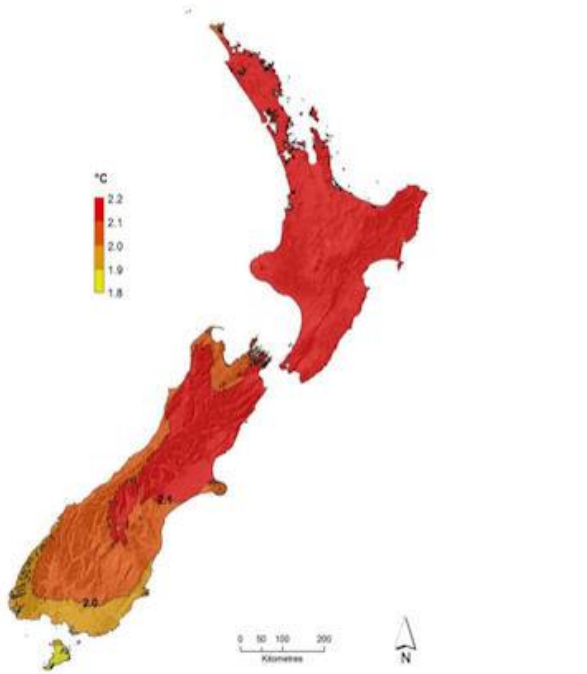
IES INTEGRATED ENVIRONMENTAL SOLUTIONS

The IES-VE software has been tested according to the ASHRAE Standard 140 and it meets or exceeds all requirements of this standard

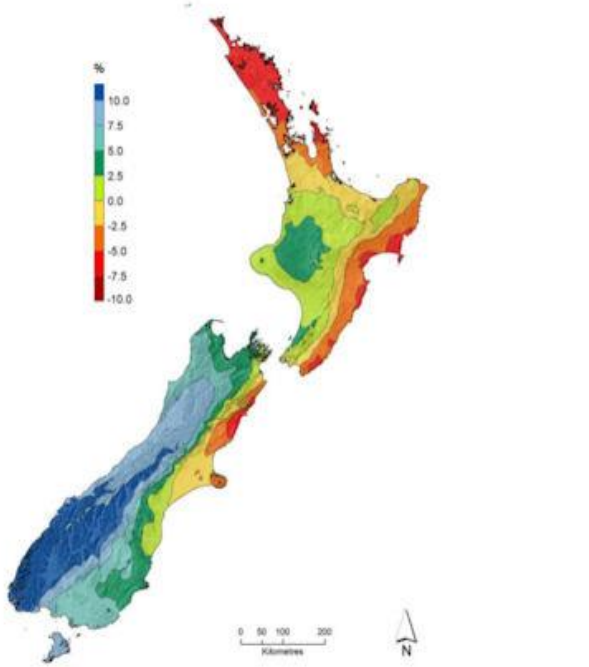


- Energy (operational carbon) based on nominal improvements as follows:
  - 10% improvement (good-practice design)
  - 20% improvement (best-practice design)
  - 30% improvement (innovative strategies EG underfloor air distribution – UFAD, chilled beam, passive cooling, daylight dimming etc.)
  - 40% improvement (world leading)

Energy analysis: External environmental factors



Projected annual mean temperature change between 1980 – 1999 and 2080 – 2099



Projected annual mean precipitation change between 1980 – 1999 and 2080 – 2099

Source: NIWA

Weather data
(TMY weather file with a 1.5°C climate shift)

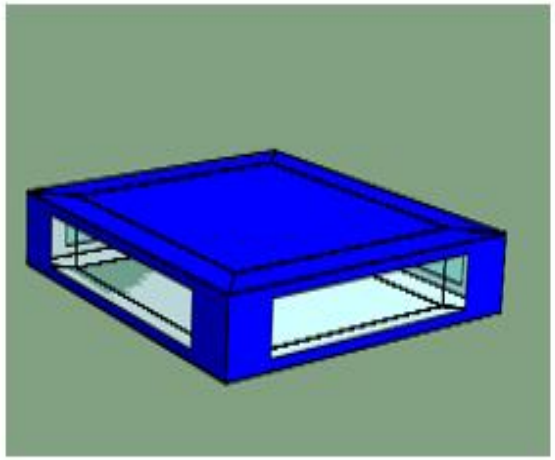
The CCWorldWeatherGen

CCWorldWeatherGen
Climate change world weather file generator

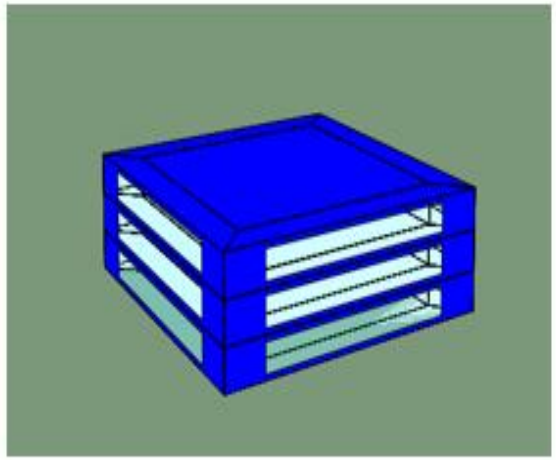
- Auckland, TMY weather file with 2020 climate shift (+1.5°C)
- Wellington, TMY weather file with 2020 climate shift (+1.5°C)
- Christchurch, TMY weather file with 2020 climate shift (+1.5°C)

- **2020**
- **2050**
- **2080**

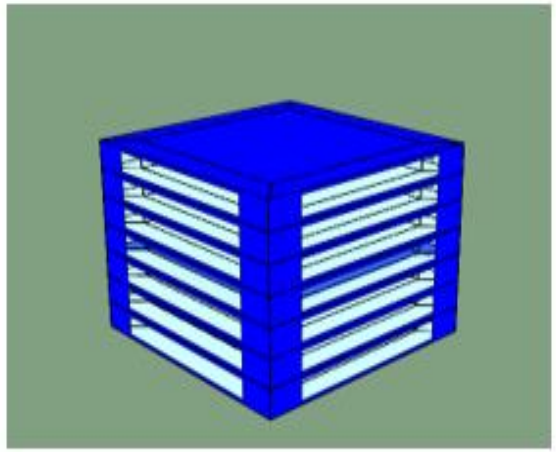
Energy analysis



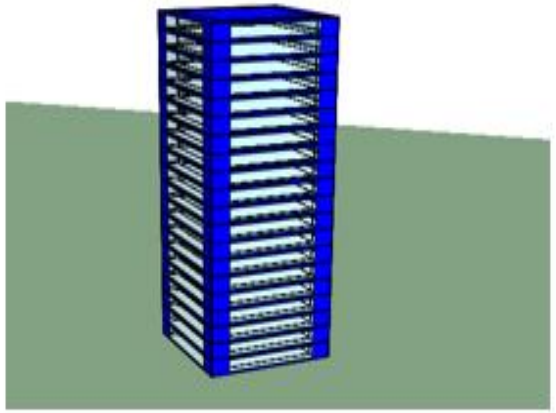
One level model for square building



Three levels model for square building

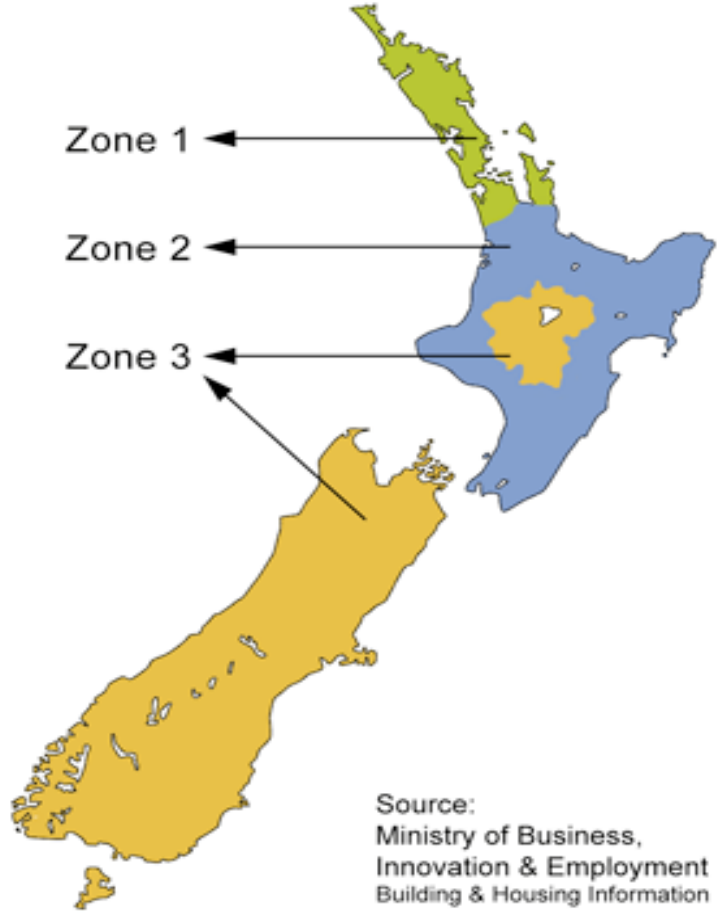


Seven levels model for square building



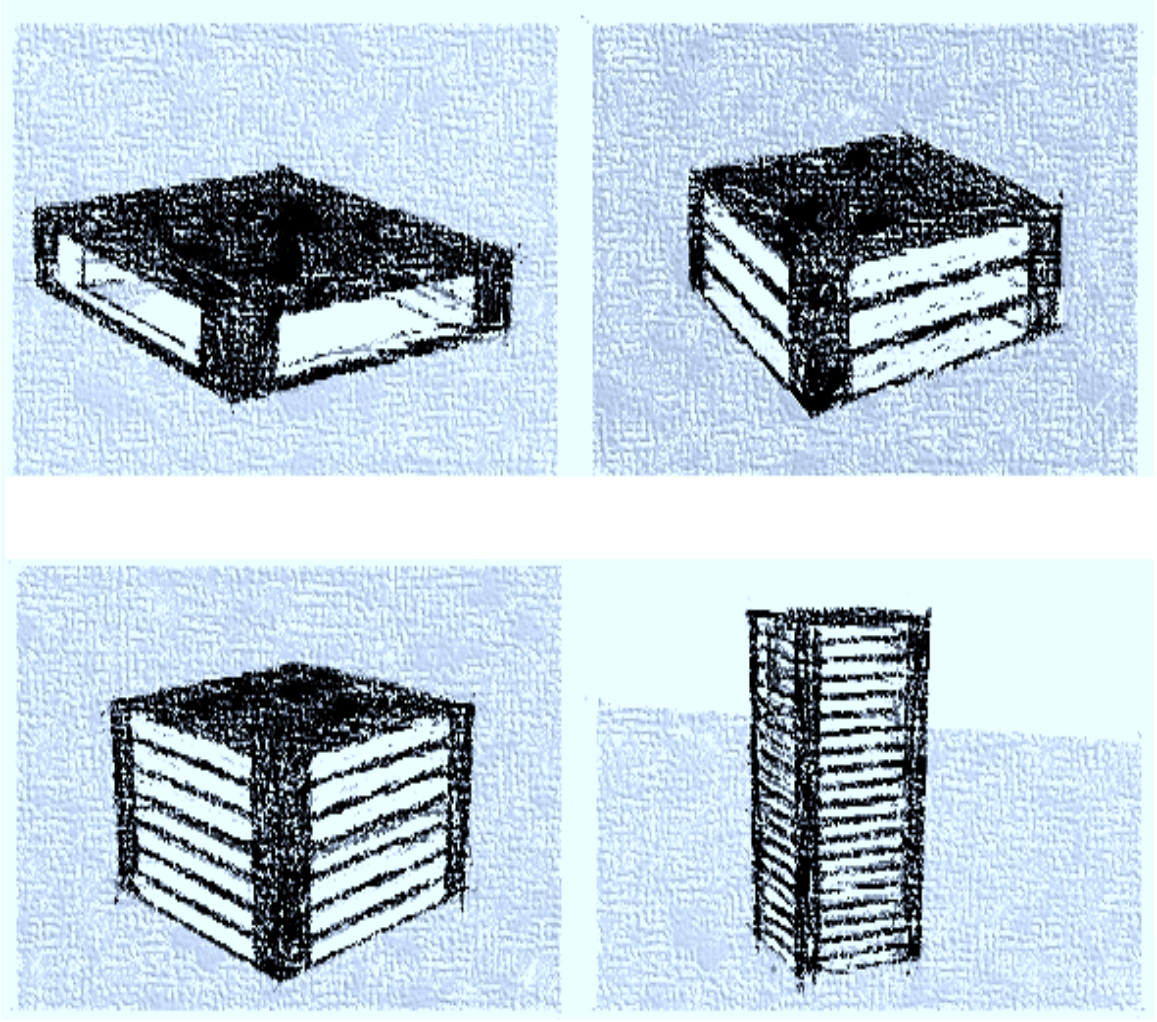
Twenty levels model for square building

Building fabric



- *NZS 4243-1:2007*
- *Each floor has been zoned with a conditioned space of 3 m floor to ceiling height and 1 m ceiling space that is unconditioned representing the structural and ceiling void space*

Energy analysis



Internal gains/loads

Energy analysis

Building element	Minimum R-values	
	Climate zone 1 (Auckland)	Climate zone 2 (Christchurch and Wellington)
Roof	1.9	1.9
External Wall	0.3	1.2
Exposed floor	1.3	1.3

Description	Standard	Thermal Properties	
Single glass in aluminium frame	NZBC H1 minimum	U-value glass and frame	6.58 W/m2.K
		SHGC $_{COG}$	0.8
Double glass units in aluminium frame	NZS 4218:2009 (Table C1)	U-value glass and frame	4.22 W/m2.K
		$SHGC_{COG}$	0.7
Insulated glass units with a low emissivity coating (low-e) in aluminium frame	NZS 4218:2009 (Table C1)	U-value glass and frame	3.44 W/m2.K
		$SHGC_{COG}$	0.5

- *Vertical transportation, mechanical ventilation fans and domestic hot water usage calculated separately*

Building Type	Equipment Load (W/m^2)
Office	8.1
Hotel	2.7
Retail	2.7

Building Type	Occupancy W/m^2
Office	2.7
Hotel	2.9
Retail	2.4

Building Type	Lighting Load (W/m^2)
Office	9
Hotel	6
Retail	10

Square Building	Rectangular Building
North	North
45 degrees from North	East/West
	North East
	North West

Energy analysis

→ MM →

BRANZ

IES INTEGRATED ENVIRONMENTAL SOLUTIONS

AUCKLAND (ZONE 1)

NORTH

Single Glazing		Double Glazing		Low E	
ng plant sensible oad (MWh)	Heating plant sensible load (MWh)	Cooling plant sensible load (MWh)	Heating plant sensible load (MWh)	Cooling plant sensible load (MWh)	Heating plant sensible load (MWh)
28.5662	62.598	30.9133	53.4252	19.2998	61.1193
139.5973	91.029	155.2651	65.3538	97.8804	80.7401
386.0065	157.0271	435.2775	101.3857	277.4323	126.7504
1191.4047	374.5281	1352.0066	222.5786	865.4921	280.1434
239.1373	838.9787	112.5782	284.6647	54.7121	313.7526
239.1373	838.9787	265.9575	633.3133	127.9678	699.6579
824.4302	1864.1133	920.6297	1289.4843	460.6291	1436.1263
41.0383	111.2995	44.2935	93.6	27.4157	103.8061
186.8893	180.4058	205.0649	131.1832	130.1254	148.1811

45 NORTH

BRANZ GROUPS	Single Glazing		Double Glazing		Low E	
	Cooling plant sensible load (MWh)	Heating plant sensible load (MWh)	Cooling plant sensible load (MWh)	Heating plant sensible load (MWh)	Cooling plant sensible load (MWh)	Heating plant sensible load (MWh)
1 Storey Office	28.9679	62.9922	31.4273	53.821	19.5664	61.3709
3 Storey Office	141.555	92.5067	157.7252	66.7527	99.2765	81.6806
7 Storey Office	391.2358	160.5976	441.6686	104.4893	281.1456	128.9706
20 Storey Office	1207.2822	384.8641	1371.1862	231.0938	876.7072	286.4726
3 Storey Hotel	104.9205	374.8936	116.8763	286.7443	56.4959	314.8033
7 Storey Hotel	247.4841	843.4642	276.1552	638.1866	132.2051	702.1306
20 Storey Hotel	851.8923	1878.1243	953.3902	1304.3658	475.0372	1444.3002
1 Storey Retail	42.0171	111.8894	45.4429	94.233	27.9819	104.1496
3 Storey Retail	190.7203	182.4127	209.5297	133.1827	132.367	150.3781

WELLINGTON (ZONE 2)

NORTH

Single Glazing		Double Glazing		Low E	
g plant sensible oad (MWh)	Heating plant sensible load (MWh)	Cooling plant sensible load (MWh)	Heating plant sensible load (MWh)	Cooling plant sensible load (MWh)	Heating plant sensible load (MWh)
17.1976	78.6673	21.2446	63.2707	9.6538	71.0248
91.4237	137.8013	112.8229	94.8339	58.6392	108.8553
253.3207	262.9029	314.484	166.8637	170.4796	190.9239
781.9177	671.2552	973.4594	403.3898	537.0472	460.0864
58.9548	497.4113	72.2959	369.107	24.1615	392.6814
138.7974	1136.0811	170.3573	836.6573	56.5029	890.8551
488.5685	2782.7178	594.0277	1935.5417	211.2266	2051.3472
25.3839	133.7164	30.4772	106.5353	14.3748	115.2089
123.5839	260.4377	146.9514	183.3215	78.4375	196.8805

45 NORTH

BRANZ GROUPS	Single Glazing		Double Glazing		Low E	
	Cooling plant sensible load (MWh)	Heating plant sensible load (MWh)	Cooling plant sensible load (MWh)	Heating plant sensible load (MWh)	Cooling plant sensible load (MWh)	Heating plant sensible load (MWh)
1 Storey Office	17.6069	78.8608	21.857	63.5169	9.9255	71.1306
3 Storey Office	93.4271	138.7657	115.623	95.8794	59.9419	109.3925
7 Storey Office	258.7381	265.3968	321.7057	169.4111	173.9757	192.2746
20 Storey Office	798.405	678.7075	995.0159	410.7533	547.6638	464.0827
3 Storey Hotel	62.0481	497.9615	76.3234	370.1857	25.6603	393.0172
7 Storey Hotel	146.1087	1137.3948	179.8528	839.187	60.0526	891.6569
20 Storey Hotel	511.1364	2787.51	623.1584	1943.4735	223.3597	2054.6118
1 Storey Retail	26.194	133.9577	31.5989	106.9013	14.8277	115.3472
3 Storey Retail	126.9053	261.5105	151.2342	184.6242	80.2399	197.4671

CHRISTCHURCH (ZONE 3)

NORTH

Single Glazing		Double Glazing		Low E	
e plant sensible	Heating plant sensible	Cooling plant sensible	Heating plant sensible	Cooling plant sensible	Heating plant sensible

45 NORTH

BRANZ GROUPS	Single Glazing		Double Glazing		Low E	
	Cooling plant sensible	Heating plant sensible	Cooling plant sensible	Heating plant sensible	Cooling plant sensible	Heating plant sensible

Reformatted data in Excel + VBA code

Scenario	Location	Building Type	Climate Change(kgCO2 equiv.)	Ozone Depletion Potential(kgCFC 11 equiv.)	Acidification Potential(kgSO2 equiv.)	Eutrophication Potential(kgPO4 equiv.)	Ozone Formation Potential(kgC2H2 equiv.)	Mineral Depletion(kgSb equiv.)	Fossil Fuel Depletion(MJ)	GFA	No. of Storeys	StrSysType	StrSysMat
0	Invalid Selection	Invalid Selection	0	0	0	0	0	0	0	0	0	Invalid Selection	Invalid Sele
2R10RC2	Auckland	Commercial Office	1644269.23850652	0.112999011857144	23643.3262617182	2819.59442038262	1755.99501107896	3.24262515307452	40821276.1598468	18688	10	Frame and Shear-walled frame s	Reinforced Co
2R10RC3	Auckland	Commercial Office	1882160.79596844	0.120507174850778	25498.3273313077	3003.42660971963	1867.04411181326	3.52573002830759	43171984.7887987	18688	10	Frame and Shear-walled frame s	Reinforced Co
2R10RD2	Auckland	Commercial Office	4652195.2872322	0.161281290232624	35871.4032386993	3504.14934015908	2245.4133029496	5.45724196204451	46522320.1965684	18688	10	Frame and Shear-walled frame s	Reinforced Co
2R10RD3	Auckland	Commercial Office	4890086.84469413	0.168789453226258	37726.4043082888	3687.98152949609	2356.4624036839	5.74034683727758	48873028.8255203	18688	10	Frame and Shear-walled frame s	Reinforced Co
2R10SC2	Auckland	Commercial Office	1380358.67064858	6.63792273364565E-02	17251.900515526	2466.48630977266	2050.70896297922	0.975767473771197	41394686.1596293	18688	10	Frame and Shear-walled frame s	Steel
2R10SC3	Auckland	Commercial Office	1643941.05157502	6.923645099757 35E-02	18693.3763647433	2648.8430181697	2231.41486509218	1.01290294629189	44434561.8273974	18688	10	Frame and Shear-walled frame s	Steel
2R10SD2	Auckland	Commercial Office	4431454.49868939	0.115135186588561	29716.5754598665	3180.93168478563	2569.72275098379	3.19669460034851	47593714.4824697	18688	10	Frame and Shear-walled frame s	Steel
2R10SD3	Auckland	Commercial Office	4695036.87961583	0.117992410249678	31158.0513090838	3363.28839318267	2750.42865309675	3.23383007286921	50633590.1502378	18688	10	Frame and Shear-walled frame s	Steel
2R15RC2	Auckland	Commercial Office	2739248.50068078	0.182199199430844	38273.3743590584	4528.98284797694	2808.23755756373	5.295969181223	65231204.9430151	28032	15	Frame and Shear-walled frame s	Reinforced Co
2R15RC3	Auckland	Commercial Office	3150808.49545916	0.195188561287242	41482.5854746581	4847.01840876286	3000.35604972866	5.7857496602604	69298005.973614	28032	15	Frame and Shear-walled frame s	Reinforced Co
2R15RD2	Auckland	Commercial Office	7455000.95439555	0.257770280877104	57501.8262180249	5619.55552912341	3594.74640573635	8.74877691552304	74524700.1909769	28032	15	Frame and Shear-walled frame s	Reinforced Co
2R15RD3	Auckland	Commercial Office	7866560.94917392	0.270759642733503	60711.0373336246	5937.59108990933	3786.86489790128	9.23855739456044	78591501.2215758	28032	15	Frame and Shear-walled frame s	Reinforced Co
2R15SC2	Auckland	Commercial Office	3251145.98000696	0.114938851816481	32847.9885594608	4599.3060999349	3946.84874708225	1.66205367169573	77117688.3848799	28032	15	Frame and Shear-walled frame s	Steel
2R15SC3	Auckland	Commercial Office	4027323.24243357	0.123352585813539	37092.7365375579	5136.29620606889	4478.9776849626	1.77140737469637	86069282.0598152	28032	15	Frame and Shear-walled frame s	Steel
2R15SD2	Auckland	Commercial Office	7992069.9498805	0.19076617055787	52212.6118599856	5707.22401930601	4750.61660880857	5.11774479431806	86701163.8907247	28032	15	Frame and Shear-walled frame s	Steel
2R15SD3	Auckland	Commercial Office	8768247.2123071	0.199179904554928	56457.3598380828	6244.21412544	5282.74554668893	5.2270984973187	95652757.56566	28032	15	Frame and Shear-walled frame s	Steel
2R1FC2	Auckland	Commercial Office	-55283.4103269385	4.81236764994258E-03	766.834913369396	137.538160930571	142.270270632983	6.90398953248711E-02	2095081.78302919	1869	1	Frame and Shear-walled frame s	Timbe
2R1FC3	Auckland	Commercial Office	-70751.3088121083	5.587796444417 64E-03	863.274855628213	155.337027977589	152.586851830729	8.043225693581 79E-02	2398609.73007927	1869	1	Frame and Shear-walled frame s	Timbe
2R1RC2	Auckland	Commercial Office	218998.037660538	6.109484458098 38E-03	1615.71814494661	166.119811009925	111.508419308931	0.219162773687152	2235624.79656256	1869	1	Frame and Shear-walled frame s	Reinforced Co
2R1RC3	Auckland	Commercial Office	240963.104787214	6.802730178596 84E-03	1786.99460153171	183.093454050946	121.761834680245	0.245302489004199	2452671.05655205	1869	1	Frame and Shear-walled frame s	Reinforced Co
2R1RD2	Auckland	Commercial Office	176541.376892191	5.571872524476 92E-03	1376.61229534903	136.423453479874	82.4104955864641	0.210094570029191	1744481.15122349	1869	1	Frame and Shear-walled frame s	Reinforced Co
2R1RD3	Auckland	Commercial Office	198506.444018867	6.265118244975 39E-03	1547.88875193414	153.397096520895	92.6639109577781	0.236234285346238	1961527.41121298	1869	1	Frame and Shear-walled frame s	Reinforced Co
2R1SC2	Auckland	Commercial Office	175674.274993095	2.174744418363 51E-03	984.907388234938	122.667802472181	120.405426536843	3.553743079318 02E-02	2031260.06441644	1869	1	Frame and Shear-walled frame s	Steel
2R1SC3	Auckland	Commercial Office	189066.791276906	2.319918819 0546E-03	1058.14820469433	131.933274534789	129.58702178658	3.742426943046 85E-02	2185714.94200823	1869	1	Frame and Shear-walled frame s	Steel
2R1SD2	Auckland	Commercial Office	132619.633087165	1.629560485676 96E-03	742.433850614861	92.553186385369	90.8976729027921	2.634150595693 82E-02	1533198.90294583	1869	1	Frame and Shear-walled frame s	Steel
2R1SD3	Auckland	Commercial Office	146012.149370976	1.774734887218 92E-03	815.674667074254	101.818658447977	100.079268152529	2.822834459422 65E-02	1687653.78053762	1869	1	Frame and Shear-walled frame s	Steel
2R1TC2	Auckland	Commercial Office	40080.3518631166	3.769186275228 56E-03	842.38397606137	124.25300183581	98.3178807773657	5.790699481904 97E-02	2083337.31842745	1869	1	Frame and Shear-walled frame s	Timbe
2R1TC3	Auckland	Commercial Office	24612.4533779468	4.544615069703 62E-03	938.823918320187	142.051868882828	108.634461975112	6.929935642999 65E-02	2386865.26547753	1869	1	Frame and Shear-walled frame s	Timbe
2R20RC2	Auckland	Commercial Office	3888721.17961364	0.252946928139551	53308.5930017912	6279.81291889229	3887.9109409153	7.40525891597099	90194987.8444686	37376	20	Frame and Shear-walled frame s	Reinforced Co
2R20RC3	Auckland	Commercial Office	4473957.21207772	0.271417728736127	57872.073428611	6732.05772435999	4161.10237240545	8.10172404369691	95977956.3792267	37376	20	Frame and Shear-walled frame s	Reinforced Co
2R20RD2	Auckland	Commercial Office	10303188.9033363	0.355691688396746	79486.1228572525	7770.030570548	4965.26468838874	12.094318926535	102975525.580957	37376	20	Frame and Shear-walled frame s	Reinforced Co
2R20RD3	Auckland	Commercial Office	10888424.9358004	0.374162488993321	84049.6032840723	8222.2753760157	5238.4561198789	12.7907840542609	108758494.115715	37376	20	Frame and Shear-walled frame s	Reinforced Co
2R20SC2	Auckland	Commercial Office	5836465.22065077	0.171177220424869	52345.7301868387	7226.18853599605	6332.86295629478	2.44634578706284	121080044.342992	37376	20	Frame and Shear-walled frame s	Steel

Copy of BRANZ LCAConcept (Commercial) V1.0h.xlsm - modFormControls (Code)

(General) (Declarations)

```
End Select
LCAHeatingEnergy = Worksheets("DataEnergy").Cells(2 + inp, 21 + intH).Value 'Cell U+,2+
End Function

Function LCAHeatingSourceCOP(Source, Sink)
Dim dblCOP As Double: dblCOP = 1
Select Case Source & Sink
    Case "Electric ImmersionDHW"
        dblCOP = 1 / 0.98
    Case "Electric ImmersionHeating"
        dblCOP = 1 / 0.98
    Case "Gas FiredDHW"
        dblCOP = 1 / 0.91
    Case "Gas FiredHeating"
        dblCOP = 1 / 0.91
    Case "Biomass FiredDHW"
        dblCOP = 1 / 0.84
    Case "Biomass FiredHeating"
        dblCOP = 1 / 0.84
    Case "Electric Heat PumpDHW"
        dblCOP = 1 / 2.2
    Case "Electric Heat PumpHeating"
        dblCOP = 1 / 2.7
End Select
LCAHeatingSourceCOP = dblCOP
End Function

Function LCACoolingVentSourceCOP(CoolingType, FanOrHVAC)
Dim dblCOP As Double: dblCOP = 1
Select Case CoolingType
    Case "Natural Vent"
        dblCOP = 0
    Case "Mechanical Vent"
        If FanOrHVAC = "Fan" Then dblCOP = 1
    Case "Cooling"
        If FanOrHVAC = "HVAC" Then dblCOP = 1 / 3
    Case "No Cooling"
        If FanOrHVAC = "HVAC" Then dblCOP = 0
End Select
```

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Assess Building

BRANZ LCAConcept (Commercial)

whether one building type will have significantly different foundation options than another or if all building types being considered are likely to have broadly similar foundation options. Total building weight is likely to be the key determiner of this if height, GFA and location remain the same between options.)

- ETABS used as the primary structural analysis software.

Other

- Carbon footprint values used for timber/engineered wood product options assume sourcing from sustainable forestry.
- Excludes embodied carbon from services, refrigerant leakage and fit out.
- Excludes operational waste (construction waste is included).

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Welcome

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Possible future developments

User feedback invited!

Tool

- **Online tool?**
- **Updating library when LCAQuick is next updated**
- **Incorporate MBIE embodied CO_2 reporting format (separate out biogenic)**

Structural

- **More flexibility of grids?**
- **More floor systems?**

Façade

- **Provide more façade type options?**
- **Ability to select window/wall ratio?**
- **Façade life to replacement – ability to adjust?**

Energy

- **Updated New Zealand electricity grid factors**
- **New climate zones and H1 changes?**
- **Zero Carbon Act impacts**

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Thank you