# Embodied Carbon Reduction: Guidance, Steps, Results

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### Let's Talk About

- ANSI 1500
- Analysis Tools
- Operational and Embodied Carbon: Modeled Versus Actual
- Drivers
- Action Items
- Case Studies
- Questions/Answers/Discussion



The RESNET/International Code Council Standards Development Committee 1500 — Embodied Carbon is responsible for proposed Standard RESNET/ICC 1550 to provide a standardized method to calculate and report the embodied carbon impact of homes.



HERS ratings and the HERS carbon index are a very large and growing part of the residential market.

Raters also provide services for **PHIUS**, **Energy Star and DOE Zero Ready Homes** programs.

Creating a standard that enables **HERS raters** to create an embodied carbon assessment using the **same areabased models they already build to do their energy ratings.** 



TOOL	Early Design Hotspot	Enclosure Comparison	Individual Material Comparison	LCCA + ESG	Net Zero Carbon	Residential	Retrofit Avoided Carbon	Whole Building LCA
Autocase				x	2			
BEAM	x	x	x			x		
Building Ease			x					
CARE				80 - 2			x	
COVE	x							
EC3			x		5	Ì		
eTool	x	x	x	x	x	x	x	x
<u>Kaleidoscope</u>		x						
<u>OneClick</u>	x	x	x	x	x	x	x	x
PH Ribbon		x			x			
Tally	x	x	x	x	x	x	x	x
ZGF			x					

- Direct side-by-side material comparisons
- Assembly comparisons
- Design development
- Whole building models and comparisons
- "Alternative" materials with EPDs or LCA studies





### 1- INPUT DIMENSIONS on the project sheet.

ex: 100 m<sup>2</sup> of exterior walls.

				Non-essential Read-only	ns calculations	Desta la desta di sec
Project Information	descent of the laboratory					Basic Instructions
Project Name	Insulation	Comparaison	Construction Ye	ar		1. Fill in this sheet according to the Input Legend above.
Designer			Number of Bedr	boms		Tip: If your plans are PDFs, you might like to use this free
Engineer			Stories Above G	rade		tool to help take measurements from them:
Builder / Developer			Total Floor Area			A <sup>2</sup> CARCINE
Development Project	-		Above Grade Co	nditioned Area		bottom of the window, from 'Footings & Slabs' to 'Garage
Address			Below Grade Co	nditioned Area	() () () () () () () () () () () () () (	In The sequence is not important.
City						<ol> <li>Devices excitable extentions in the DEVICH short</li> </ol>
Province / State (Can./US only)						A RETER MATERIA SHOLINGS IN THE REVIEW SHOL.
country Indian Trace	Canada	-				4. View material carbon results in the RESULTS sheet.
sunding type	Single Deta	Iched House *	1			
Construction Type	New Const	ruction *				For full instructions and more, see the
DIMENSION NAME	QTY	UNIT	DESCR	UPTION		USED TO CALCULATE TAKE-OFFS FOR
DIMENSION NAME	QTY 0.0	UNIT m <sup>s</sup> Length (m)	DESCI Height (m)	Width (m)		USED TO CALCULATE TAKE-OFFS FOR Continuous (aka 'strip'') foundation wall foctings
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### 2- SPECIFY + SELECT on the section sheets,

Specify additional factors -> e.i.

ex: Compare 100m<sup>2</sup> of different cavity insulation with R-Value: 20 and select materials by checking the box.

	EXTERIOR WALLS		Laboration		SUBTOTA	u. (kg CO <sub>2</sub> e)	c	IMAT
	1	SECTION COMPLETE			2	271		ACTIO
CATEGORY	MATERIAL	QUANTITY	UNITS		SELECT	(kg CO_e)	EMISSIONS (kg CO <sub>2</sub> e)	STORAGE (kg CO re)
STRUCTURAL S	SHEATHING	~~~~~~						
SYPSUM PANELS								
	Gypsum panels - glass mat / USG / Securock ExoAir 430 / 1/2"	100.0	0 m²	100%		611	611	0
	Gypsum panels - glass mat / 5/8" Type X / Gypsum Association [Industry Avg	100	0 m <sup>1</sup>	1805	0	542	542	0
	N.America] Gensum sapels - slass mat / 1/2" / Gensum Association Industry Ave I							
	N.America]	100.0	0 m²	100%		471	471	0
DRIENTED STRAND	BOARD (OSB)							
	OSB sheathing / 5/8" / AWC & CWC [Industry Avg   US & CA]	100.0	0 m²	100%		385	385	0
	OSB sheathing / 1/2" / AWC & CWC [Industry Avg   US & CA]	100.0	0 m <sup>1</sup>	100%		308	308	0
LYWOOD					-			
	Plywood / 3/4" / AWC & CWC [Industry Avg   US & CA]	100.0	0 m <sup>3</sup>	100%	ш	418	418	0
	Plywood / 5/8" / AWC & CWC [Industry Ava   IIS # 0.1]	100.0	0 m <sup>3</sup>	100%		349	349	0
MASSING STREET	Di Awe & CWC [Industry Avg   US & CA]	100.0	0 m²	100%		279	279	0
NOOD BOARDS		N.		-	-			
	Wood / SPF / 3/4" boards / AWC & CWC [Industry Avg   US & CA]	100.0	0 m*	100%		120	120	0
CAVITY INSUL	ATION	R-VALU	E 20.0					
IIGH R-VALUE CAV	ITY INSULATION	-	Ale and					
	Aerogel blanket / Aspen Aerogets / R9.6/inch	100.0	0 m²	100%		6,499	6,499	0
<b>SPRAY POLYURETH</b>	ANE FOAM - HIGH DENSITY							
	Spray polyurethane foam - High Density (HFC gas) / R 6.3/inch / SPFA [Industry Avg   US & CA]	100.0	<sup>1</sup> m 0	100%		5,995	5,995	0
	Spray polyarethane foom - High Density (HFO gas) / R 6.5/inch / SPFA Juduates Ave 115 & CAT	100.0	0 m²	100%		1,744	1,744	0
PRAY POLYURETH	ANE FOAM - CLOSED CELL							
	Spray polyarethane foam - Closed Cell (HFC gas) / R 6.6/inch / SPFA	100 /	n mi	1009		4 6 2 5	4 6 3 5	0
	[industry Avg   US & CA]	100.0	0 111-	100%	0	4,000	4,000	v
	[industry Avg   US & CA]	100.0	0 m²	100%		1,465	1,465	0
	Spray polyurethane foam - Closed Cell (HFO gas) / Huntsman / Heatlok Soya HFO & Heatlok HFO / R 6 S/Inch	100.0	<sup>2</sup> m 0	100%		882	882	0
PRAV POLYURETH	ANE FOAM - OPEN CELL							
	Spray polyurethane team - open centre schnicht for the pressent rough sec	1000	1.102	100%		500	500	0
UFFD WOOL DIGU	CA	100.1		-			300	
HEEP WOUL INSU	Word / Havalock Word / Lonse fill / 8.4.4/inch	100 (	0 m2	1005	N 100	171	620	2.40
	Wool / Hendlock Wool / Batta / B 2 6/inch	100.0	0 ml	1005		254	020	512
AINERAL WOOL BA	TT INSIII ATION	100.0	0.01	100%	LUI	334	720	010
HITLIOIL HOUL DA	Mineral wool batt / Owens Coming / Thermafiber UltraBatt / R 4.3/inch	100 (	0 m <sup>2</sup>	100%		1 409	1.409	0
	Mineral wool batt / Rockwool / ComfortBatt R24 (5.5') / R 4.4/inch	100.0	0 m <sup>2</sup>	100%	n	600	600	0
	Mineral wool batt / IBEAM Avg]	100.0	0 m3	100%	ň	597	597	0
	Mineral wool batt / Rockwool / ComfortBatt R15 (3.5') / R 4.3/inch	100.0	0 m <sup>2</sup>	1803	ñ	461	461	0
	Mineral wool batt / Rockwool / Safe'n'Sound, ComfortBatt / R 3.8/inch	100.0	0 m <sup>1</sup>	100%	ñ	461	461	0
	Miperal wool batt / Reckwool / ComfortBatt B14 (3.5") / B 4 O/inch	100.0	0 m <sup>1</sup>	100%	ň	415	415	0
	Mineral wool batt / Reckwool / ComfortBatt R22 (5.5") / R # 0/inch	100.0	0 m <sup>2</sup>	100%	ä	415	415	0
	Mineral wool batt / Rockwool / ComfortBatt R24 SS (6" Steel Studiat / R	100.0		1007	0	410	410	
	4.0/inch	100.0	0 m²	100%	U	415	415	d
								10



### **3-** REVIEW materials selection on the review sheet.

Quickly identify selected materials with highest and lowest carbon footprint

Windows -

BEAM	ACTION	<b>REVIEW PROJECT MATERIALS</b>	11,745	13,519	1,774
SECTION	CATEGORY	MATERIAL	NET EMISSIONS (bg CO2+)	CARBON EMISSIONS (kg CO <sub>2</sub> e)	CARBON STORAGE (bg CO26)
footings & Siets	CONTINUOUS CONCRETE FOOTINES	Concrete - 0-25 MPa, 0-14% TA/SL, GU / CRMCA Endustry Avg ( CAE	1,225	1,225	0
Foreings & State	CONCRETE SLABS	Concreter = 0-25 MPa, 0-14% FA/SL, DU / CRMCA [Instastry Avg.] CA]	2,645	2,645	0
fundings & Ticto	REBAR FOR CONTINUOUS FOOTINGS	Rebar / Concrete Reinforcing Steel Institute [Industry Avg   N.Americe] / TOM	60	60	0
feetings & Slabs	REINFORCING MESH FOR SLAB	Welded wire mesh / Serfas / 6' x 6' x 6' x 6'Cg / Norway	107	107	0
footings & Siete	SUB-SLAB INSULATION	EPS foam board / R.4.Drinch avg [REAM Avg.: US & CA]	656	656	0
feelings & Slubs	AGGREGATE BASE	Approprie / US Average [Industry Avg]	105	106	0
Foundation Walls	CONCRETE FOUNDATION WALLS	Concrete - 0-25 MPa, 0-14% FA/SL, BU / CRMCA [Industry Avg   CA]	928	928	0
Poundation Wells	REBAR FOR FOUNDATION WALLS	Rebar / Concrete Reinforcing Steel Institute [Industry Avg.) N.America] / 15M	90	90	0
Foundation Walls	CONTINUOUS INSULATION	XPS foars board / R 5 0/inch (DCAM Arg   US & CA)	328	328	0
Extensor Walls	LIGHT WOOD FRAME WALLS	Wood / SPF / 2x8 Lumber / AWC & CWC [Industry Avg   US & CA]	256	256	0
Canadian Walls	STRUCTURAL SHEATHING	Phywood / 1/21 / AWC & OWC (Industry Avg.) US & CA)	279	279	0
Cetarior Walls	CAVITY INSULATION	Wool / Havelock Wool / Loose-All / R 4.4/inch	271	620	349
Exterior Walls	CONTINUOUS INSULATION	Wood (fair board / GUTEX / Molti-Therm / R 3.6/inch, 40, 60, 80, 102, 122, 140, 160, 180, 200 mm	-382	387	769
Exterior Walls	ADDITIONAL MATERIALS	Mineral woul luent / [BEAM Avg]	383	383	0
Exterior Wall Cladding	EXTERIOR WALL CLADDING	Fiber Cement Cladding / James Hardie / HardiePlank / 8 mm	681	734	53
Exterior Wall Cladding	STRAPPING / FURBING	Wood 2 EPF / 3x2 Lumber / AVIC & CWC [Industry Avg   US & CA]	11	11	0
Exterior Wall Cludding	INTERIOR CLADDING FOR EXTERIOR WALLS	Drywell 1/2" IDEAM Avg   US & CAL	163	163	0
Exterior Wall Claiding	INTERIOR CLADOING FOR EXTERIOR WALLS	Drywell 5/K" Type X / Oypsum Association Jodiastry Avg J US & CA	98	98	0
Windows.	WINDOWS - DOUBLE-GLAZED	Window - double-glazed / Vinyi frame / DICA Study (US & CA)	1,770	1,770	0
Interior Walia	LIGHT WOOD FRAME INTERIOR WALLS	Wood / SPF / 2x8 Lumber / AVIC & CWC Industry Avg I US & CAI	16	16	0
interior Wolls	LIGHT WOOD FRAME INTERIOR WALLS	Wood / SPE / 2x4 Lumber / AWC & CWC [Industry Avg   US & CA]	83	83	0
nterior Walls	CLADDING FOR INTERIOR WALLS	Drywell 1/2" [BEAM Avg   US & CA]	370	370	0
Floors	LIGHT WOOD FLOOR FRAMING	Wood I Joist / TJI 238/360 / 9-1/2" Depth / AWC & CWC [Industry Avg   US & CA]	129	129	0
Floors	SUB FLOORING	Plywood / 1/2" / AWC & CWC (Industry Avg.) US & CA)	75	75	0
floars	FLOOR GAVITY INSULATION	Fiberghain hatt / R.B. S/irich (BEAM Avg)	20	20	0
Cellings	CEILING FINISHES	Drywell 1/2" [BEAM Avg   US & CA]	253	253	0
Roof	WOOD ROOF FRAMING	Wood / SPF / 2x32 Lumber / AWG & CWC (Industry Avg ) US E GA)	134	134	0
Roof	ROOFING	Metal Panels - Steel / Canadian Sheet Steel Building Institute / 24 gauge [Industry Avg   pa)	1,182	1,182	0
Roof	ROOF CAVITY INSULATION	Dellalose / locus Ell / R 3.7/inch / CIMA [Industry Avg   US & CA]	-414	190	604
Roof	ADDITIONAL MATERIALS	Phywood / 1721 / WWC & CWC [Industry Avg   US & CA]	220	220	0
			1		



### **4-** SHARE

materials carbon results from the **results sheet**.

Represents the carbon footprint for the structure, enclosure and partitions of the whole building.





### 5- Save, Compare and track multiple projects.

Using the **BEAM menu** you can :

-Save projects

- -Load previous project
- -Toggle units between Metric or Imperial

P 785 - CAS %	.000123 - Babutu Co	- New project		- co 🗉 🖾
- Test House		Save project		1. (A. 1.)K
BERNIE BUILDING EMESSI Accounting Portantification	IONS	Load project Toggle units (Metric<>Imperi	Load project Toggle units (Metric<>Imperial)	
Project Information		Clear this section		
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uniong type	Single Decaded Hause		L. A. Manual Co.	
miner line incomed theme	Schumitte Bestern		Per tal net terms	the field of the second s
Building Dimension Inputs Dimension matter	Tacluding Dumpit) QTY UNIT	DESCRIPTION	USED TO CALCULA	TE TAKE-OFFS FOR
ONTINUOUS POOTINGS VOLUME	0.0 m <sup>3</sup> Longth (r	n) Height (w) Width (m)  X   X   Extent to ope	Continuous (aka "strip") fou (exterior and interior)	ndation wall torrings.
OLUMIN PARIS & PIERS VOLUME	m <sup>a</sup> Entiri (pina) Castadora pa	ne of discordovous science fastings, pait, pers, etc.	Discontinuous (puting elem continuous featings feet, an	enta saide from ut int.)
UNINDATION WALL AREA	100.0 m <sup>a</sup> Tital Jean prints to	dalian wall contace area (contactive bingstix (seight)) acrest party wild. Exclusion approach, guing facilitation	Foundation & tracement wa interior framing, and woll of	( anaulation (ext. and int.) adding
OUNDATION SLAB AREA	100.5 m <sup>4</sup> Total Journ	dation white outface ones	Aggregate base, sub-stals in basement flooring	dialatice, shitt, and
CTERIDR WALL AREA	100.0 m <sup>4</sup> Statute an	nte of exterior scala. No enco: Celoudes winters kator econogi, pode wille, goldge eisite	Franking, Insulation, sheathy Internet clatticing of extentor	ng, extarior cladding, and walls
INDOW AREA	and Area of white the	ndow frames (preferrable) or rough openings quering sees, stangets, Tathatise gampe virstowe	Windows of main building	
ARTY WALL AREA	m <sup>a</sup> Prail area t Typical fortu	dari partitorna thus unit from othera restourses & accelerent units	Party wall framing, insulance cladding	in, sheathing, and interior
NTERIOR WALL AREA	en* One side o	nly (cs. camtrilines of all interior walls.	interior wall friming and cla	dilling Consistence both



Energy Use Intensity Carbon Equivalent Usage Embodied Carbon Accounting

### **Energy: Modeled vs. Actual Emissions**

	211 W	29th	511 E	86th	Columbus (	Commons	Cornell	Tech	Hotel M	arcel
				Site	e Energy Consu	Imption kBtu	u/sf.yr			
	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual	Predicted	Actual
Heating	0.42	3.75	0.81	1.36	0.6	1.1	1.06	5.2	5.55	7.2
Cooling	0.79	1.09	1.18	1.39	0.4	4.1	0.92	1.9	1.34	3.8
Domestic Hot Water	4.53	9.4	5.81	10.04	4.4	9.1	5.88	7.8	2.69	8.4
Lighting and Plug Loads	8.48	16.63	7.21	20.02	9.7	8.9	9.81	16.94	20.49	42.9
Total EUI	14.2	30.69	15.0	33.1	15.1	23.2	17.7	31.8	30.1	62.3

### **Energy: Modeled vs. Actual Emissions**



Columbus Commons		Hotel M	1arcel	Canaan Parish		
5 Stories over Amenity/Retail, 80 units, 110,600 GSF		Renovated 165 Room	Hotel, 111,000 GSF	4 story MF, 40 units, 61,500 GSF		
ASHP, NG Cent	ASHP_NG Central DHW_FRV		/H, ERV	ASHP, NG Tankless, Exhaust Only		
HERC Panga	27 /2	Modeled EUI	30.1	HERS Range	49 - 60	
Carbon Index	48 - 53	First Year, Actual EUI	62.3	Carbon Index	70 - 89	
Modeled Total Building EUI	15.0			Modeled EUI	35.0	
Actual Total Building EUI*	18.0	Second Year, Actual EUI*	42.0	Actual Total Building EUI*	45.0	
* July 2023 -	June 2024	*After Final Cx, and HP Drye	rs replaced Electric Dryers	* July 2023 - J	lune 2024	

### Hotel Marcel vs. Industry Benchmarks

### EUI by End Use



Source: EIA Commercial Buildings Energy Survey 2022

### **Energy: Modeled vs. Actual Emissions**



### **Energy: Modeled vs. Actual Emissions**



### **Operational Carbon Emissions**

Columbus	
5 Stories over Amenity/Ret	ail, 80 units, 110,600 GSF
Operational Carbon Emissions (kg CO <sub>2</sub> e •yr)	148,948
Operationsl Carbon Emissions (kg CO <sub>2</sub> e/sf ·yr)	1.35
	Actual kBtu/sf·yr 18



Canaan Parish

4 story MF, 40 units, 61,500 GSF

Operational Carbon	207 094
Emissions (kg CO <sub>2</sub> e •yr)	207,984
Operationsl Carbon	2.20
Emissions (kg CO <sub>2</sub> e/sf ·yr)	5.38

Actual kBtu/sf·yr 45

## **Embodied Carbon Emissions**

Footings & Slabs	97,535 kg CO <sub>2</sub> e
Foundation Walls	24,004 kg CO <sub>2</sub> e
Structural Elements	29,112 kg CO2e
Exterior Walls	50,984 kg CO2e
Party Walls	19,625 kg CO2e
Exterior Wall Cladding	45,234 kg CO2e
Windows	55,620 kg CO2e
Interior Walls	36,908 kg CO2e
Floors	65,009 kg CO2e
Ceilings	18,212 kg CO2e
Roof	64,584 kg CO2e
Garage	0
NET TOTAL	644,717 kg CO <sub>2</sub> e

Average home is ~184 kg  $CO_2e/m^2$ Canaan Parish ~113 kg  $CO_2e/m^2$ Canaan Parish ~130 occupants





# Drivers

### Code





### Code





**2024 IECC - What Happened?** 



### Code

### APPENDIX CD THE 2030 GLIDE PATH

This voluntary appendix is suited for adopting authorities that wish to extend beyond the mandatory provisions of this code toward zero net energy goals. Appendix CD is intended to be adopted by jurisdictions that will require new construction to operate at zero net energy by the year 2030. It **reduces** the net annual energy use of buildings **by** approximately **one-third in comparison with** buildings constructed in compliance with the **2021 IECC**. It is assumed that the **2027 and 2030 editions** will also **reduce** energy use **by one-third** each.



**2024 IECC - What Happened?** 



### **Stretch Code**



#### 2023 TECHNICAL **GUIDANCE** MASSACHUSETTS STRETCH ENERGY CODES -----...................... -----........................ ................. -----.............. -------------........... ............. -----Analyzine a A reference and instructional guide for DDER **Massachusetts Energy Stretch and Specialized Codes**

### **Ordinances, Articles, Carrots, and Sticks**

Boston's Building Emissions Reduction and Disclosure Ordinance (**BERDO**) - requirements for large existing buildings to reduce their greenhouse gas

The Building Energy Use Disclosure Ordinance (**BEUDO**) – enacted by the Cambridge City Council



Estimated average ranges for compliance (2025-2050)

### **Ordinances, Articles, Carrots, and Sticks**



Low Embodied Carbon Building is a building or structure that has been designed, engineered, and constructed to minimize and mitigate greenhouse gas Emissions from the extraction, harvesting, fabrication, transportation, installation, maintenance, and disposal of building products and materials, and from other construction-related activities, in accordance with the standards of Article 37-5.4.

### **Mass Stretch, Carrots and Sticks**

Clean Energy Application	HERS Target	HERS Target with R406.5.2 EC Credit
Mixed Fuel Building	42	45
All-Electric Building	45	48

### Add Subsection R406.5.2, Embodied Carbon Credit

1. Insulation: new dwelling units that demonstrate a calculated insulation GWP intensity (kg CO2e/ft2) less than 0... based on table default values, or product specific EPDs or calculations in the approved tools: EC3 and BEAM, may be used ... OR

2. Low GWP Concrete Mix Credit: new dwelling units that demonstrate a calculated concrete mix GWP  $\leq$  70% of the 2022 NRMCA Northeast Benchmark average . . .

# Northland Newton Embodied Carbon Case Study

#### Overview

Material ingredients: Using the data included in the Carbon Leadership Forum 2021 Materials Baselines Report, specifications were written that identified lower embodied carbon targets than the average for structural and enclosure material components.

Component	Steel Baseline	CLT Baseline	CLT Design
CLT Floor Plates and Glulam Structure	No	Yes	Yes
Roof -Level Concrete Topping	Yes	No	No
Structural Slab Reduced from 12" to 4"	No	Yes	Yes
Low-EC Concrete	No	No	Yes
Low-EC Mineral Wool Insulation	No	No	Yes
GWP % Reduction From Steel Baseline	0%	44%	50%

#### Primary Contributing GWP Materials

- 28.3% Ready-Mix Concrete, 4000 PSI 20.1% Cross-Laminated Timber (CLT) and Glue-Laminated Timber (glularn)
- 9.7% XPS Insulation Boards
- 7.4% Flat Glass
- 5.4% Concrete Masonry
- 1,210,058 kgCO2 GWP of design without Biogenic (190,910.82 kgCO2) GWP of Design Including Biogenic Contribution

#### **Embodied Carbon Comparison**



#### Reduction of high embodied carbon materials:

· Mass timber (cross laminated timber floor plates and glulam posts and beams) were used as the main structural components, reducing reliance on concrete and steel.

· CLT was used as the structural diaphragm at the roof level, eliminating concrete entirely.

· 12" reinforced concrete structural slab on grade was reduced to a 4" soil supported slab on grade.



#### Lessons Learned

Start early with a preliminary analysis and set targets for structural material GWP.

Engage the construction and design team to reduce the amount of structural materials necessary.

Work with vendors and manufacturers to ensure cost and availability and request EPDs in specifications.

Investigate structural design to reduce the amount of material needed.



#### Client Northland Investment Corp.

Stantec Architecture

Architect

// Project Team

Structural Odeh Engineers

#### Mass Timber Design Assist TimberLab

Construction Manager Cranshaw Construction

Sustainability Consultant Steven Winter Associates

Sustainability Assist Lambert Sustainability



### **EMBODIED CARBON REDUCTION CHALLENGE**

THE CHALLENGE: REDUCE UPFRONT CARBON OF BUILDINGS



# Action



Energy & Environmental Building Alliance



**Reduce Massing** 

**Optimize Required Strength** 

Optimize Formulations: SCMs, PLC/Type 1L (Limestone), Gap-Graded Aggregate

Engage SE, CM, Ready Mix to Secure Lowest % GWP Reduction at Best Cost

Emerging tech: Pozzotive, Biochar, Natural SCMs/LC3, CarbonCure/Solidia

Novel Tech: Sublime Systems, Prometheus Materials, Blue Planet



### **Action Items**





# **Framing and Cladding**

**Reduce Massing** 

Optimize Required Strength (framing) / Optimize durability with rainscreens, species selection, etc. (cladding)

Wood Studs vs Steel Studs / Wood vs Fiber Cement

Do The Math and Know The Source: Mass Timber GWP Can Vary, Impacts Beyond GWP



# Framing

					NET EMISSIONS	GROSS EMISSIONS	STORAGE Short Cycle	STORAGE Long Cycle	SELECT Long
CATEGORY	MATERIAL	QUANTITY UN	TS %	SELECT	kg CO₂e	kg CO₂e	kg CO₂√	kg CO2 🖑	Cycle
LIGHT ST	EEL FRAME WALLS	FRAMING SPACING 16	- in						
LIGHT STEE	L FRAMING – 16 GAUGE (2X6)								
	Steel studs - Load bearing / Steel Framing Industry Assn / 600-S-137-54, 16 gauge [Industry Avg, US & CA]	200.0 ft <sup>2</sup>	1009	6	449	449	0	0	
	Steel studs - Load bearing / Scafco / 600-S-137-54, 16 gauge	200.0 ft <sup>2</sup>	1009	6	605	605	0	0	
	Steel studs - Load bearing / MarinoWARE / Structural stud and track / 600-S-137-54, 16 gauge	200.0 ft <sup>2</sup>	1009	6	456	456	0	0	
	Steel studs - Load bearing / ClarkDietrich / 600-S-137-54, 16 gauge	200.0 ft <sup>2</sup>	1009	6	438	438	0	0	
LIGHT STEE	EL FRAMING – 20 GAUGE (2X4)								
	Steel studs - Non-loadbearing / Steel Framing Industry Assn / 362-S-137-54 20EQ gauge [Industry Avg, US+Can]	200.0 ft <sup>2</sup>	1009	6	108	108	0	0	
	Steel studs - Non-loadbearing / Scafco / 362VS125-18, 20EQ gauge	200.0 ft <sup>2</sup>	1009	6	146	146	0	0	
	Steel studs - Non-loadbearing / MarinoWARE / Viper Stud Viper 20 / 20EQ gauge	200.0 ft <sup>2</sup>	1009	6	110	110	0	0	
	Steel studs - Non-loadbearing / ClarkDietrich / 362-S-125-18, 20EQ gauge	200.0 ft <sup>2</sup>	1009	6	106	106	0	0	
LIGHT W	DOD FRAME WALLS	FRAMING SPACING 16	.0 in						
FRAMING L	UMBER – SPRUCE-PINE-FIR								
	Wood / SPF / 2x8 Lumber / AWC & CWC [Industry Avg   US & CA]	200.0 ft <sup>2</sup>	1009	6	54	54	0	650	
	Wood / SPF / 2x8 Lumber / Surfaced Dry Softwood Lumber Produced in British Columbia	200.0 ft <sup>2</sup>	1009	6	39	39	0	605	
	Wood / SPF / 2x6 Lumber / AWC & CWC [Industry Avg   US & CA]	200.0 ft <sup>2</sup>	1009	6	41	41	0	493	
	Wood / SPF / 2x6 Lumber / Surfaced Dry Softwood Lumber Produced in British Columbia	200.0 ft <sup>2</sup>	1009	6	30	30	0	459	
	Wood / SPF / 2x4 Lumber / AWC & CWC [Industry Avg   US & CA]	200.0 ft <sup>2</sup>	1009	6	26	26	0	314	



# Cladding

CATEGORY	MATERIAL	QUANTITY UNITS	%	SELECT	NET EMISSIONS kg CO2e	GROSS EMISSIONS kg CO₂e	STORAGE Short Cycle kg CO <sub>2</sub> -	STORAGE Long Cycle kg CO <sub>2</sub> 🍟	SELECT Long Cycie
FIRER CEMI	ENT SIDING			-		- y	•		
TIDER CEM	Fiber Cement siding [BEAM Avg]	187 8 m <sup>2</sup>	100%		1 248	1 555	307	0	
	Fiber Cement siding / Equitone / Pictura, Natura Pro, sheets / 8 mm [EU]	187.8 m <sup>2</sup>	100%	ň	2 626	3 062	436	0	
	Fiber Cement siding / Equitone / Lineall unara sheets / 10 mm [FU]	187.8 m <sup>2</sup>	100%		1 200	1 465	256	0	
	Fiber Cement siding / JamesHardie / Hardie Plank HZ5, Hardie Panel HZ5, Hardie Architectural Panel HZ5 / 8 mm	187.8 m <sup>2</sup>	100%		1,107	1,433	326	0	
	Fiber Cement siding / JamesHardie / Hardie Plank HZ10, Hardie Panel HZ10, Hardie Architectural Panel HZ10 / 8 mm	187.8 m <sup>2</sup>	100%		957	1,285	328	0	
	Fiber Cement siding / JamesHardie / Hardie Shingle HZ5 / 6.3 mm	187.8 m <sup>2</sup>	100%		859	1,123	264	0	
	Fiber Cement siding / JamesHardie / Hardie Shingle HZ10 / 6.3 mm	187.8 m <sup>2</sup>	100%		730	960	230	0	
NATURAL V	VOOD SIDING								
	Cedar Siding / Western Red Cedar Lumber Assn / 1x6 Boards [Industry Avg   CA]	187.8 m <sup>2</sup>	100%		324	324	0	1,235	
	Wood / SPF / 3/4" boards / AWC & CWC [Industry Avg   US & CA]	187.8 m <sup>2</sup>	100%		226	226	0	2,718	
	Wood cladding / BurntWood / ReUse with linseed oil treatment / 18 mm [EU]	187.8 m <sup>2</sup>	100%		635	1,095	460	5,628	
	Wood cladding / BurntWood / ReUse without surface treatment / 18 mm [EU]	187.8 m <sup>2</sup>	100%		449	449	0	5,628	
NATURAL V	VOOD SIDING								
	Cedar Siding / Western Red Cedar Lumber Assn / 1x6 Boards [Industry Avg   CA]	187.8 m <sup>2</sup>	100%		-911	324	0	1,235	
	Wood / SPF / 3/4" boards / AWC & CWC [Industry Avg   US & CA]	187.8 m <sup>2</sup>	100%		-2,492	226	0	2,718	
	Wood cladding / BurntWood / ReUse with linseed oil treatment / 18 mm [EU]	187.8 m <sup>2</sup>	100%		-4,994	1,095	460	5,628	
	Wood cladding / BurntWood / ReUse without surface treatment / 18 mm [EU]	187.8 m <sup>2</sup>	100%		-5,180	449	0	5,628	



### Wood Carbon Storage





### Wood Carbon Storage

### Short Cycle Carbon Storage







### Wood Carbon Storage

**BEAM v1.1 enables selective carbon storage for timber** 

	PROJECT NAME: Sample Project DOE Prototype SCENARIO: Baseline BEAM VERSION: V1.1	SECTION COMPLETE?				0	0	0	0	]	
CATEGORY	MATERIAL	QUANTITY	UNITS	8	SELECT	NET EMISSIONS kg CO2e	GROSS EMISSIONS kg CO2e	STORAGE Short Cycle kg CO <sub>2</sub>	STORAGE Long Cycle kg CO <sub>2</sub> 🍟	SELECT Long Cycle	
LIGHT WO	DOD FRAME WALLS	FRAMING SPACING	16.0	in				1			
FRAMING LU	JMBER – SPRUCE-PINE-FIR										
	Wood / SPF / 2x8 Lumber / AWC & CWC [Industry Avg   US & CA]	100.0	ft²	100%		-298	27	0	325		
	Wood / SPF / 2x8 Lumber / Surfaced Dry Softwood Lumber Produced in British Columbia	100.0	ft²	100%		20	20	0	302		
	Wood / SPF / 2x6 Lumber / AWC & CWC [Industry Avg   US & CA]	100.0	ft²	100%		20	20	0	246		
	Wood / SPF / 2x6 Lumber / Surfaced Dry Softwood Lumber Produced in British Columbia	100.0	ft²	100%		15	15	0	229		



N----

### **Action Items**







Find the Optimal Thermal Value (don't over-insulate)

**Choose Plant Based Products** 

**Avoid Plastic Based Products** 

Pay attention to the Chemicals (Binders, Fire Retarders, VOC's)





### **Action Items**



Net Zero As-Built - Total : 45,998 kg CO2e





Specify Lightweight Gypsum Board

~ 550 kg/m<sup>3</sup> instead of 800 kg/m<sup>3</sup>

Specify the Correct & Smallest Thickness





### Paint

Paint GWP, kg CO2e per 1 m2



### Paint



that end up in the world's oceans and waterways every year, according to a new study.

# **Case Studies**







Embodied Carbon Comparison





















#### CARBON IMPACTS OF INSULATION







Manufacturer	lanufacturer Product		Global Warming Potential* (A1 A3) per 1m2				
TimberHP	TimberBoard	3.6	- 10.3 kg CO2e				
Gutex Thermowall		5.7	- 1.2 kg CO2e				
Rockwool	Comfortboard 80	4.2	4.937 kg CO2e				
Knauf Insulation	Earthwool®Insulation Boar	4.3	6.075 kg CO2e				
Johns Manville	JMCladstone 80	4.2	8.02 kg CO2 e				
Owens Corning	Thermafiber®Fire & Sound Guard®Plus	3.5- 4.2	1.33 kg CO2e (Wabash plant) 8.78 kg CO2e (Joplin plant)				





Average home is ~184 kg  $CO_2e/m^2$ Eagleville Green ~169 kg  $CO_2e/m^2$ 

Average home is 4 beds (5 ppl)

Eagleville is 8 beds (14 ppl)

50.000



### Sample Case Study "Wrap Up" Slide

Net Zero As-Built - MCE Results per material



Net Zero As-Built - Total : 45,998 kg CO2e



### Sample Case Study "Wrap Up" Slide

Material Carbon Intensities of Different Scenarios





### Sample Case Study "Wrap Up" Slide

#### MCE per Material







## **Sample Workflow Slide**



#### Decision tree for embodied carbon analysis

## Sample Workflow Slide

considered? WLCA Compare Compare retrofit to new building CARE tool **Project stage** new build options Are you looking for Carbon rough idea or higher Avoided: resolution data? Retrofit Estimator EARLY GUIDANCE DETAILED GUIDANCE Indicators Indicators Rough High idea resolution Are you seeking holistic Are you seeking holistic environmental impacts environmental impacts or carbon only? or carbon only? CARBON ACCOUNTING WLCA WBLCA WBLCA EPIC tool CO2 ALL EcoCalculato CO2 ALL Early Phase Integrated **Revit-integrated** Carbon tool EPD Simplified LCA tool LCA for early database estimates and carbon WBLCA CARBON ACCOUNTING calculator OneClick LCA Comparison of Web-based LCA tool building systems WBLCA CARBON ACCOUNTING **Carbon Designer 3D** Impact Estimator Early estimations on carbon hot spots Desktop app

for LCA

Build Necessity

Source: Tracy Huynh, Chris Magwood, Victor Olgyay, Laurie Kerr, and Wes Sullens, Driving Action on Embodied Carbon in Buildings, RMI and U.S. Green Building Council (USGBC), 2023, https://rmi.org/insight/drivingaction-on-embodied-carbon-in-buildings/ and https://www.usgbc.org/resources/driving-actionembodied-carbon-buildings.

### **Resources**

TOOL	Early Design Hotspot	Enclosure Comparison	Individual Material Comparison	LCCA + ESG	Net Zero Carbon	Residential	Retrofit Avoided Carbon	Whole Building LCA
Autocase				x				
BEAM	x	x	x			×		
Building Ease			x					
CARE						8	x	
COVE	x							36
<u>EC3</u>			x					
eTool	x	x	x	x	x	x	x	x
<u>Kaleidoscope</u>		x						
<u>OneClick</u>	x	x	x	x	x	x	x	x
PH Ribbon		x			x			
Tally	x	x	x	x	x	x	x	x
ZGF			x					