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Wednesday, August 16th

Performance Specifications

The Key to Low-Carbon Concrete

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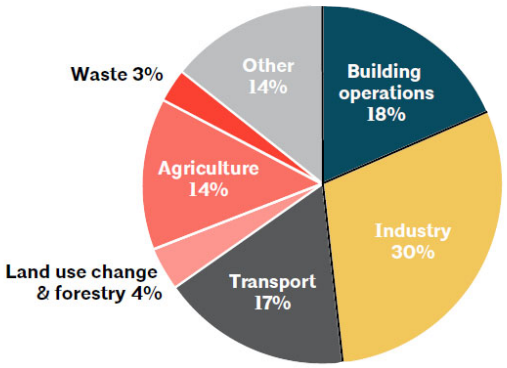
WHY ARE WE TALKING ABOUT LOW-CARBON CONCRETE?

GHG IMPACT OF BUILDINGS



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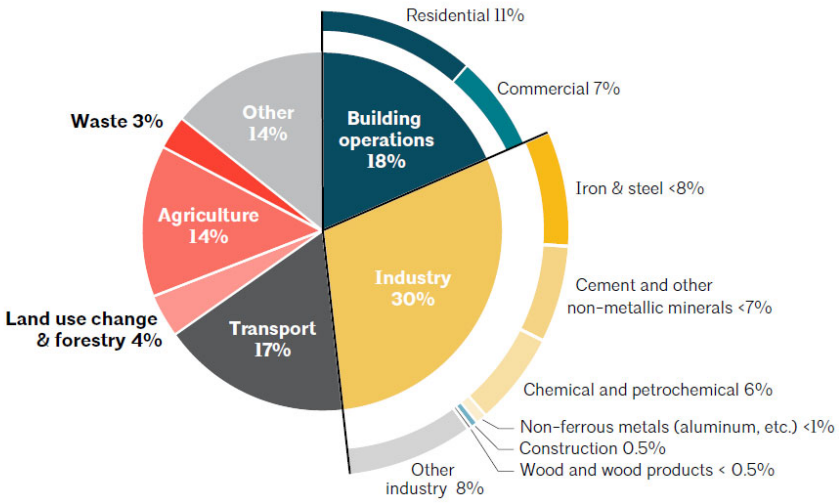
Source: AIA-CLF Embodied Carbon Toolkit for Architects

GHG IMPACT OF BUILDINGS



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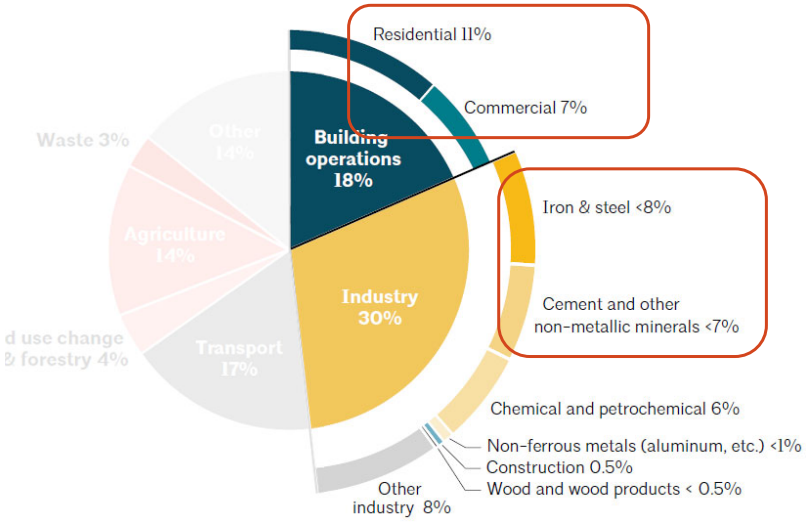
Source: AIA-CLF Embodied Carbon Toolkit for Architects

GHG IMPACT OF BUILDINGS

Steel + Cement Production:
15% of global GHG emissions

-vs-

Residential + Commercial Building Operations:
18% of global emissions



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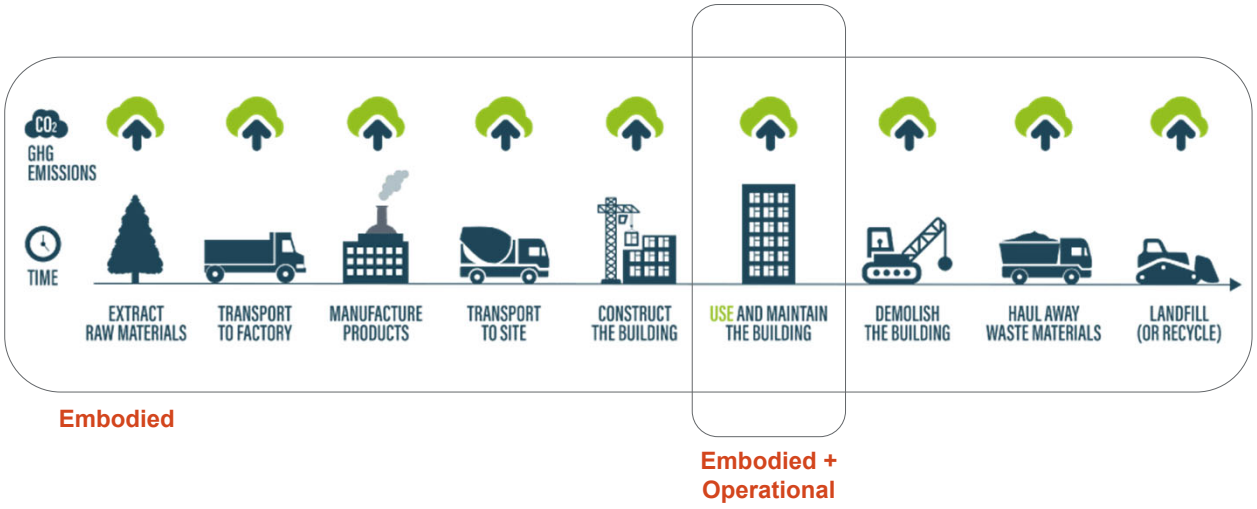
Source: AIA-CLF Embodied Carbon Toolkit for Architects

EMBODIED CARBON



Embodied

Embodied + Operational

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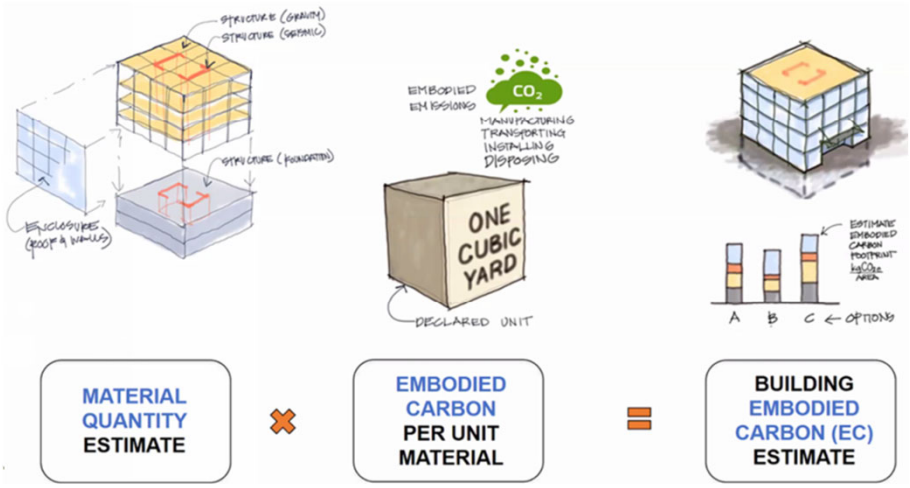
Source: Architecture 2030

QUANTIFYING EMBODIED CARBON



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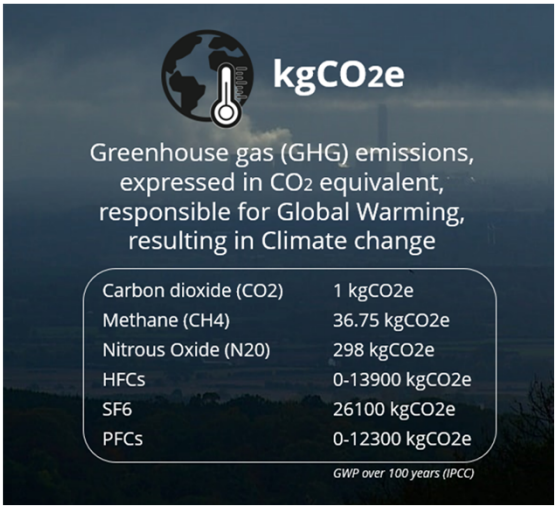
KEY TERMS

GWP Global Warming Potential (embodied carbon intensity)

kgCO2e Kilograms of CO2 equivalent (unit of measure for GWP)

EPD Environmental Product Declaration (proof of a mix's GWP value)



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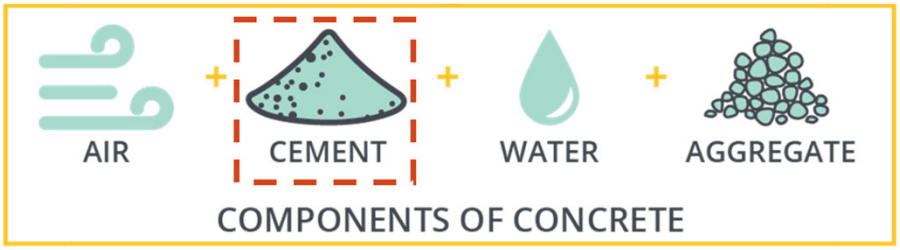
WHAT IS LOW-CARBON CONCRETE?

EMBODIED CARBON IN CONCRETE
CEMENT IS THE KEY DRIVER

Cement is 7-15% of a concrete mix by volume...



...but it accounts for 95% of the carbon emissions

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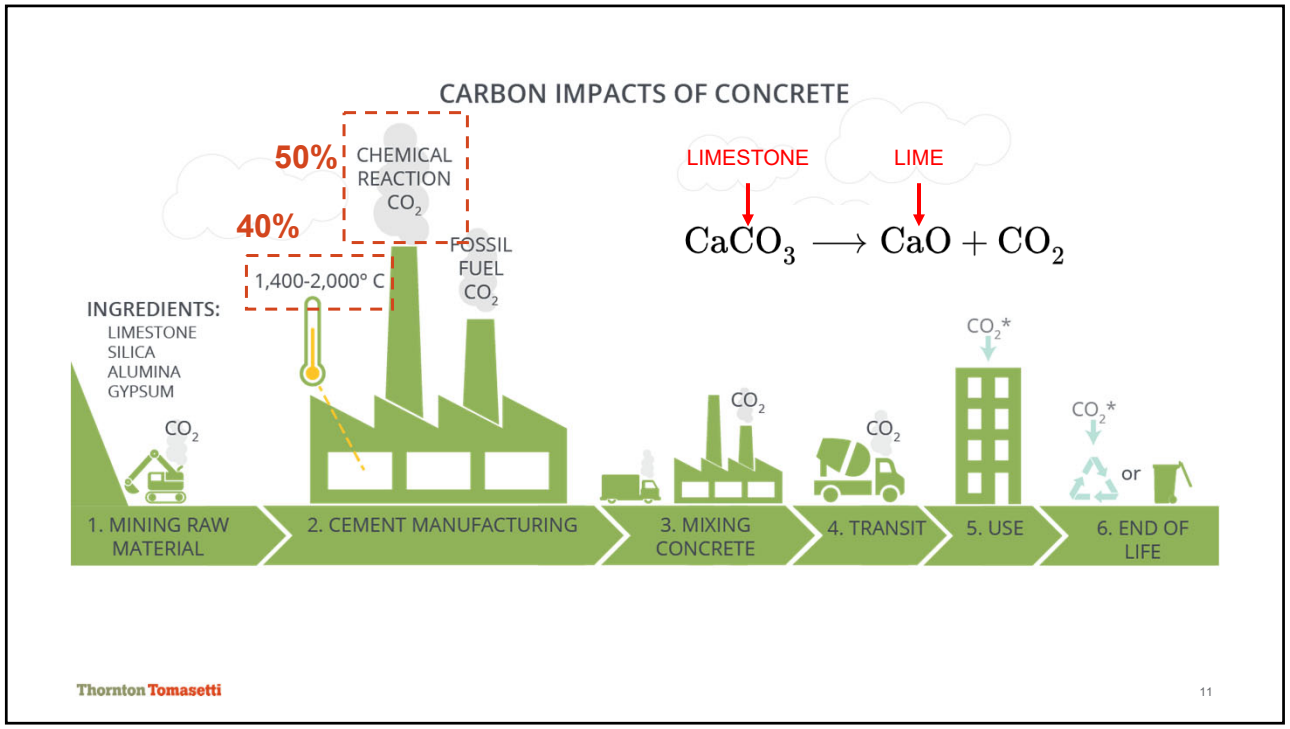

LESS CEMENT = LOWER EMBODIED CARBON

DESIGN STRATEGIES

Reduce the total cubic yards of concrete in the project

- System selection for EC
- Eliminate overdesign

"Tune" concrete strength & concrete volume to optimize for carbon (cement content scales with strength)

PROCUREMENT STRATEGIES

Reduce the pounds of cement per cubic yard

Percent of SCM roughly equals percent reduction

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HOW TO SPECIFY FOR LOW-CARBON CONCRETE

PERFORMANCE SPECIFICATIONS

033000 CONCRETE SPECIFICATIONS – REMOVE ROADBLOCKS

- Remove limits on fly ash and other cement replacements on interior concrete (use new ACI-318 maximums otherwise)
- Remove potable water requirement
- Remove arbitrary minimum W/C ratios to match current ACI limits
- Include blended hydraulic cements
- Include carbon dioxide mineralization
- Have internal system for incorporating new products

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SPECIFYING EMBODIED CARBON?

Removing the roadblocks is good, but how can we dictate carbon footprint to concrete suppliers?

Possible Strategies

Go Prescriptive — Require % fly ash or slag, dictate mix designs

Set a Cap — Set a maximum GWP for all concrete mixes

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NEW GSA STANDARDS

	Maximum Global Warming Potential Limits for GSA Low Embodied Carbon Concrete (kilograms of carbon dioxide equivalent per cubic meter - CO_2e kg/m³)		
Specified compressive strength (f'c in PSI)	Standard Mix	High Early Strength	Lightweight
up to 2499	242	326	462
2500-3499	306	413	462
3500-4499	346	466	501
4500-5499	385	519	540
5500-6499	404	546	N/A
6500 and up	414	544	N/A
These numbers reflect a 20% reduction from GWP (CO_2e) limits in proposed code language: "Lifecycle GHG Impacts in Building Codes" by the New Buildings Institute, January 2022.			

=265 KG/CY

	Global Warming Potential (GWP) - kg CO_2e / yd³							
Compressive Strength	1 - Eastern	2 - Great Lakes Midwest Region	3 - North Central	4 - Pacific North West	5 - Pacific South West	6 - Rocky Mountains Region	7 - South Central	8 - South Eastern
2500 psi	197	192	197	206	210	198	183	200
3000 psi	217	211	216	228	229	217	200	218
4000 psi	261	252	257	275	267	256	235	254
5000 psi	315	304	308	333	314	305	279	298

STANDARDS EQUATE TO APPROX. 20% CEMENT REPLACEMENT

Viable for very large owners who can shift market, but still limits our ability to encourage larger reductions

Does not allow for variations between element types

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TT'S APPROACH

- Start with a meaningful benchmark
- Base reduction goals in reality
- Use performance spec principles
- Confirm with reporting

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TT'S APPROACH

Baselines for Reduction – NRMCA!

	Global Warming Potential (GWP) - kg CO_2e / yd^3							
Compressive Strength	1 - Eastern	2 - Great Lakes Midwest	3 - North Central	4 - Pacific North West	5 - Pacific South West	6 - Rocky Mountains	7 - South Central	8 - South Eastern
2500 psi	183	178	184	180	197	177	172	189
3000 psi	201	195	202	200	213	195	188	205
4000 psi	240	231	239	242	247	230	219	237
5000 psi	289	278	285	295	289	273	257	276
6000 psi	305	293	302	312	306	290	272	292
8000 psi	361	345	352	373	349	337	313	332
3000 psi Lightweight	395	382	372	396	382	370	358	366
4000 psi Lightweight	438	422	411	440	418	406	390	399
5000 psi Lightweight	480	461	452	483	454	444	424	429

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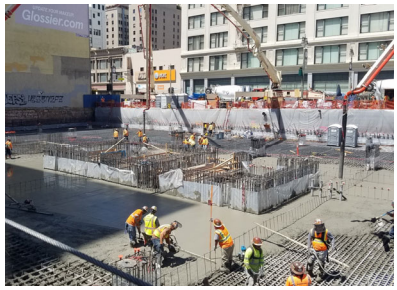
TT'S APPROACH

Setting a Reduction Goal Based in Reality



Foundations 20%-50% SCM

Flat Slabs 0%-25% SCM

Walls 20%-40% SCM

- **Look at previous mix designs for replacement percentage**
- **Talk to your suppliers!**

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TT'S APPROACH

Embodied Carbon Specs – Div 01

- Apply principles of performance specifications
- Ultimate requirement is a percent reduction in **average** GWP/cy across the entire project
- Allows for higher cement replacement in some elements (foundations, walls) and lower in others (slabs)
- Gives the supplier total flexibility
- Allows for methods beyond standard SCM's like PLC, ground glass pozzolans, alternative binders

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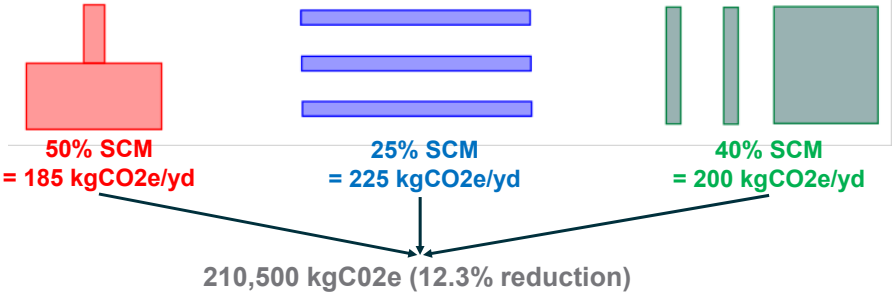
TT'S APPROACH

Example

1,000 yds 4ksi x avg 240 kgCO2e/yd = 240,000 kgC02e



210,500 kgC02e (12.3% reduction)

Target Reduction in Specs: 10%

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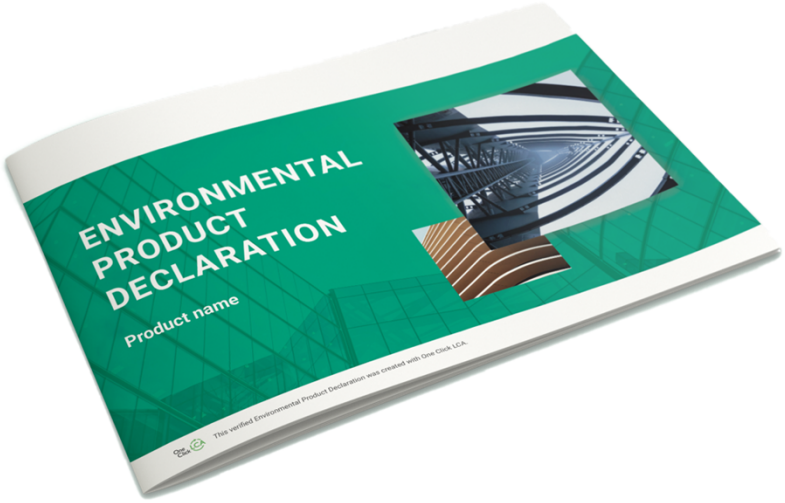
TT'S APPROACH

Reporting & Submittals

- Require EPD's (See NRMCA!)
- Or use a trusted GWP calculator
- As always, talk to your suppliers!



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THANK YOU!

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