EZ-EC

Embodied Carbon Made Eazy

10-18-20

Designas with Attitude

Andrew Swartzell
Pickard Chilton
New Haven, CT

Luke Gehron
Payette
Boston, MA

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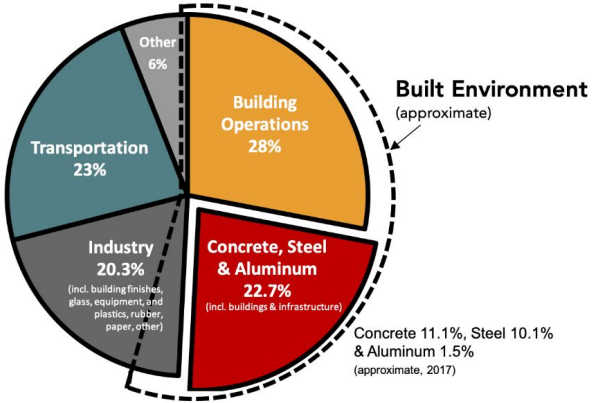
Ayers Saint Gross Architects
Baltimore, MD

Luke Lombardi
Thornton Tomasetti
Los Angeles, CA

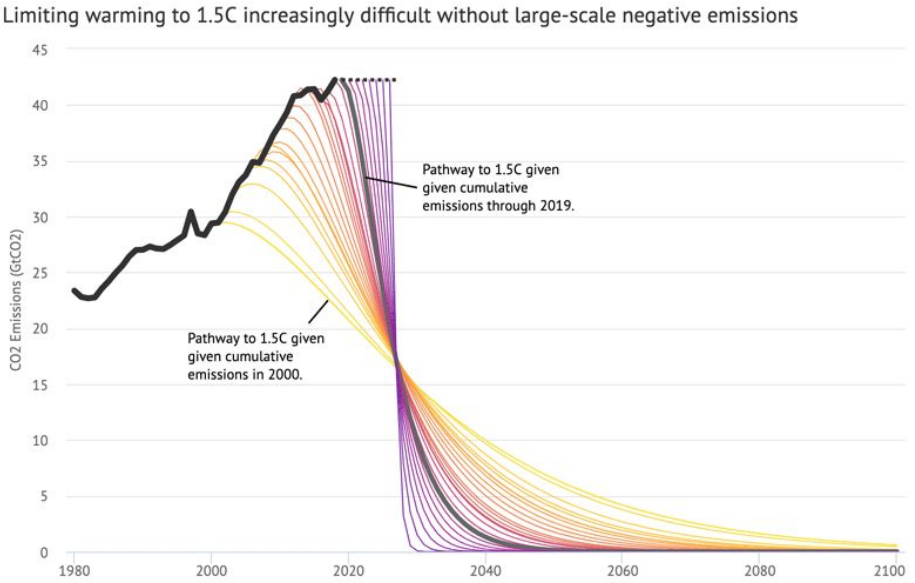
Goal

- Limit the negative environmental impact of our buildings
- Save the world

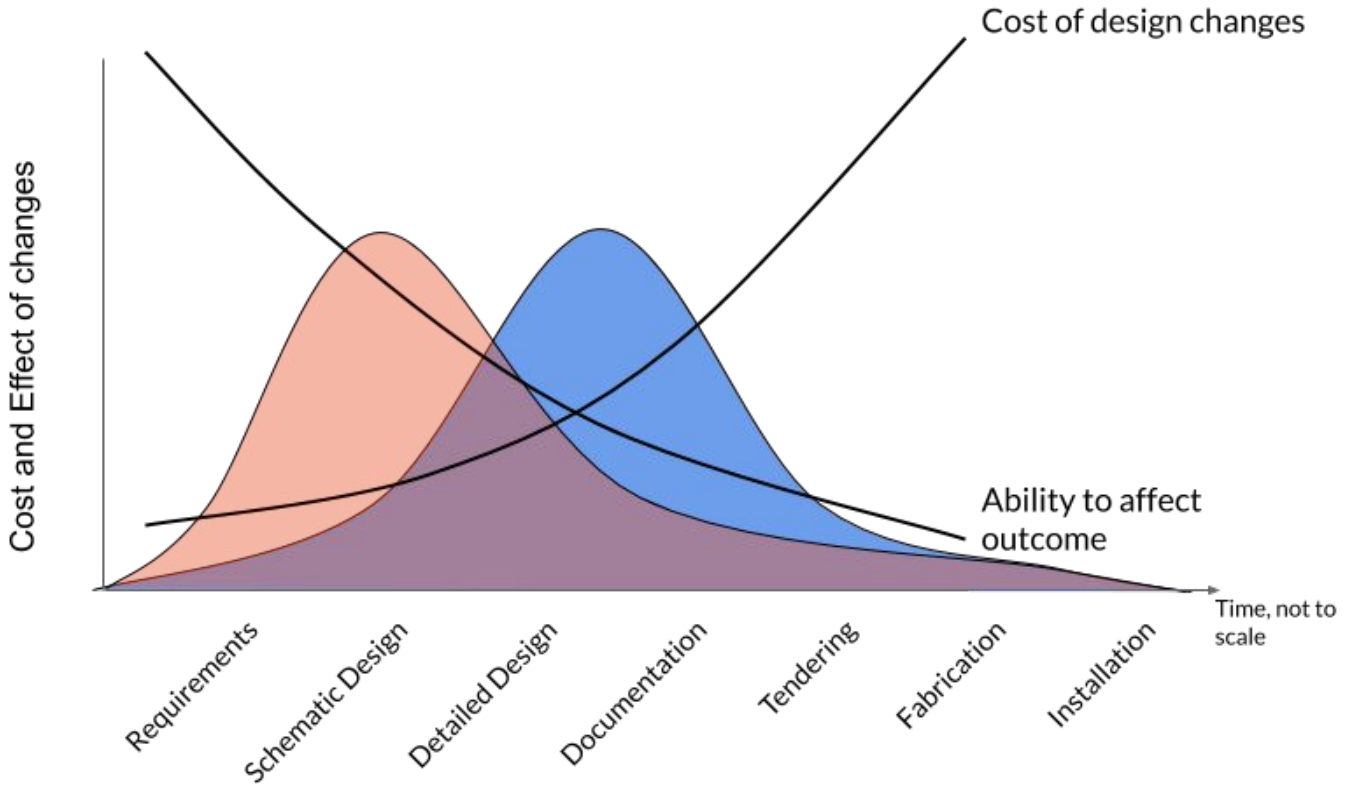


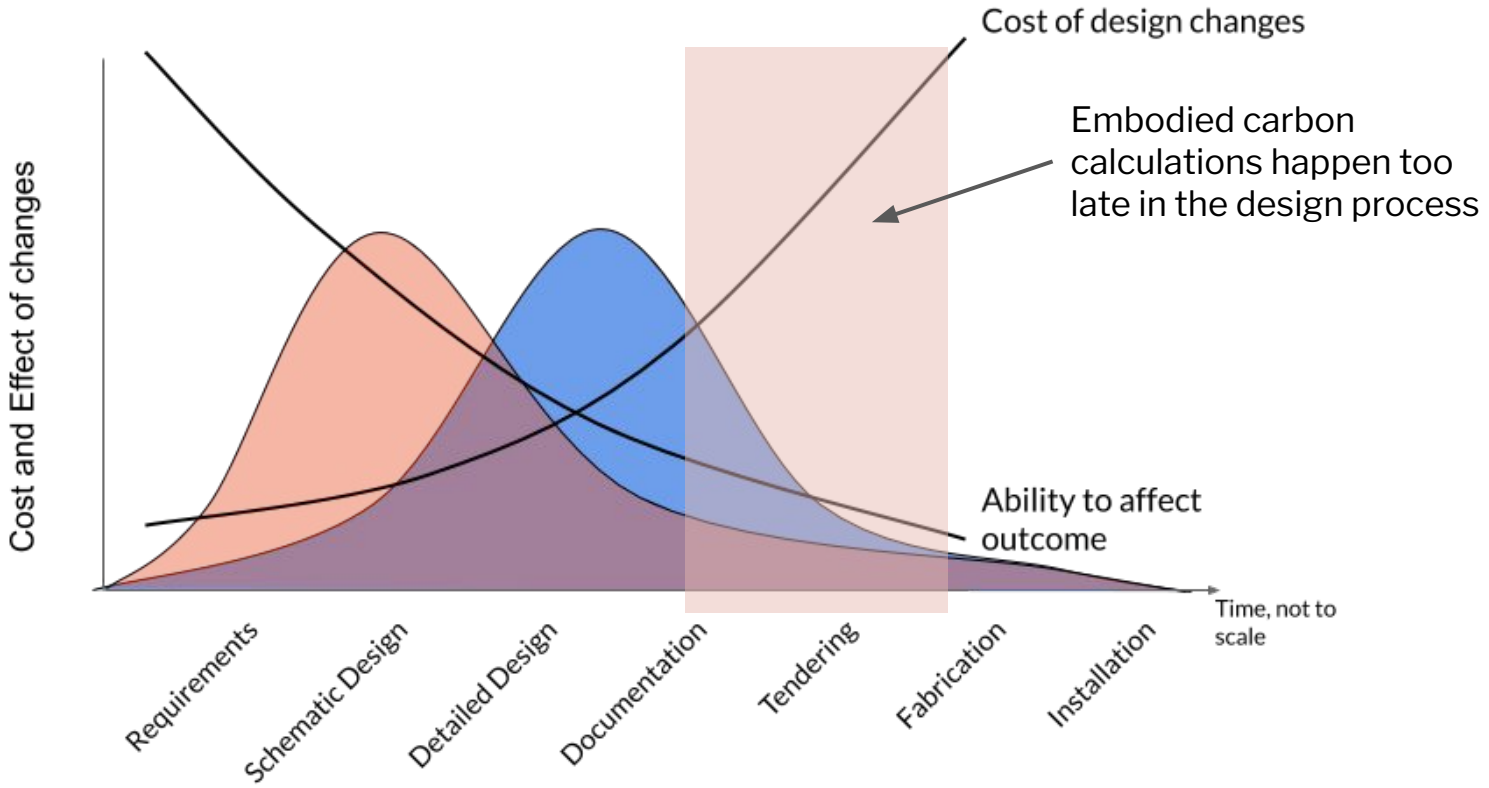
Global CO_2 Emissions by Sector

Source: IEA, Global ABC, Architecture 2030



IPCC


Cost of design changes
Cost and Effect of changes
Ability to affect outcome
Time, not to scale
Requirements
Schematic Design
Detailed Design
Documentation
Tendering
Fabrication
Installation


Cost of design changes
Embodied carbon calculations happen too late in the design process
Cost and Effect of changes
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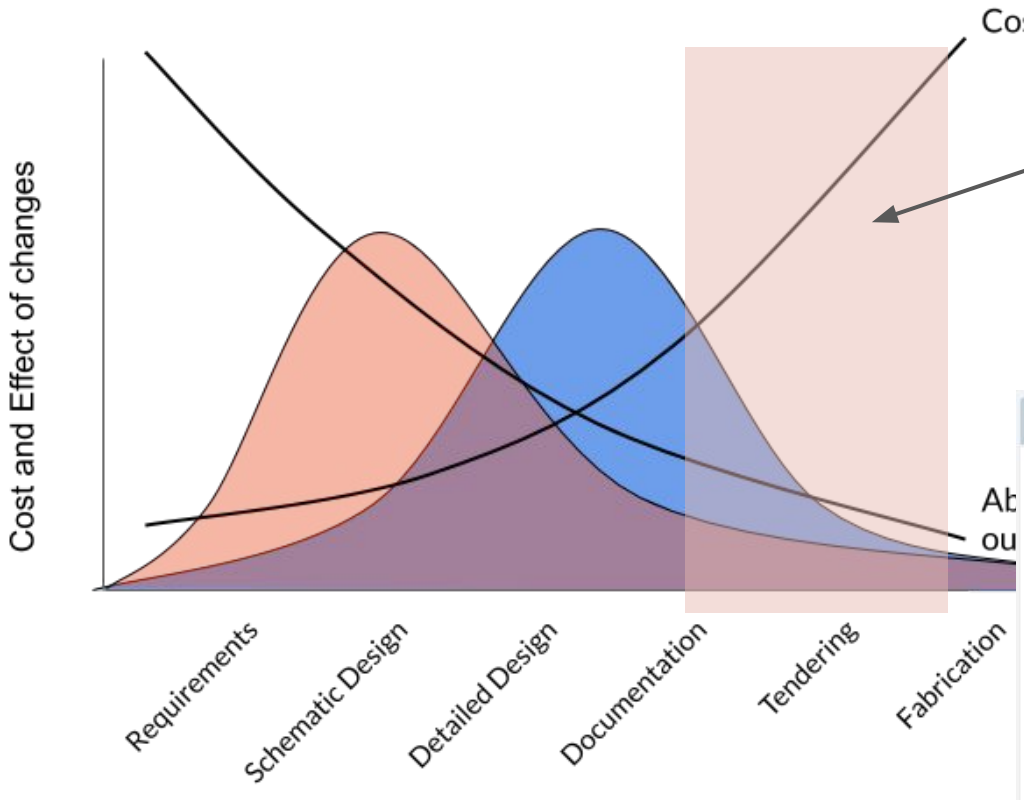
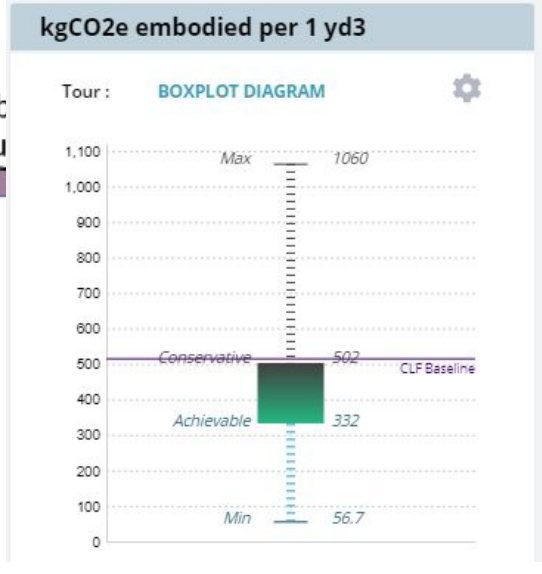
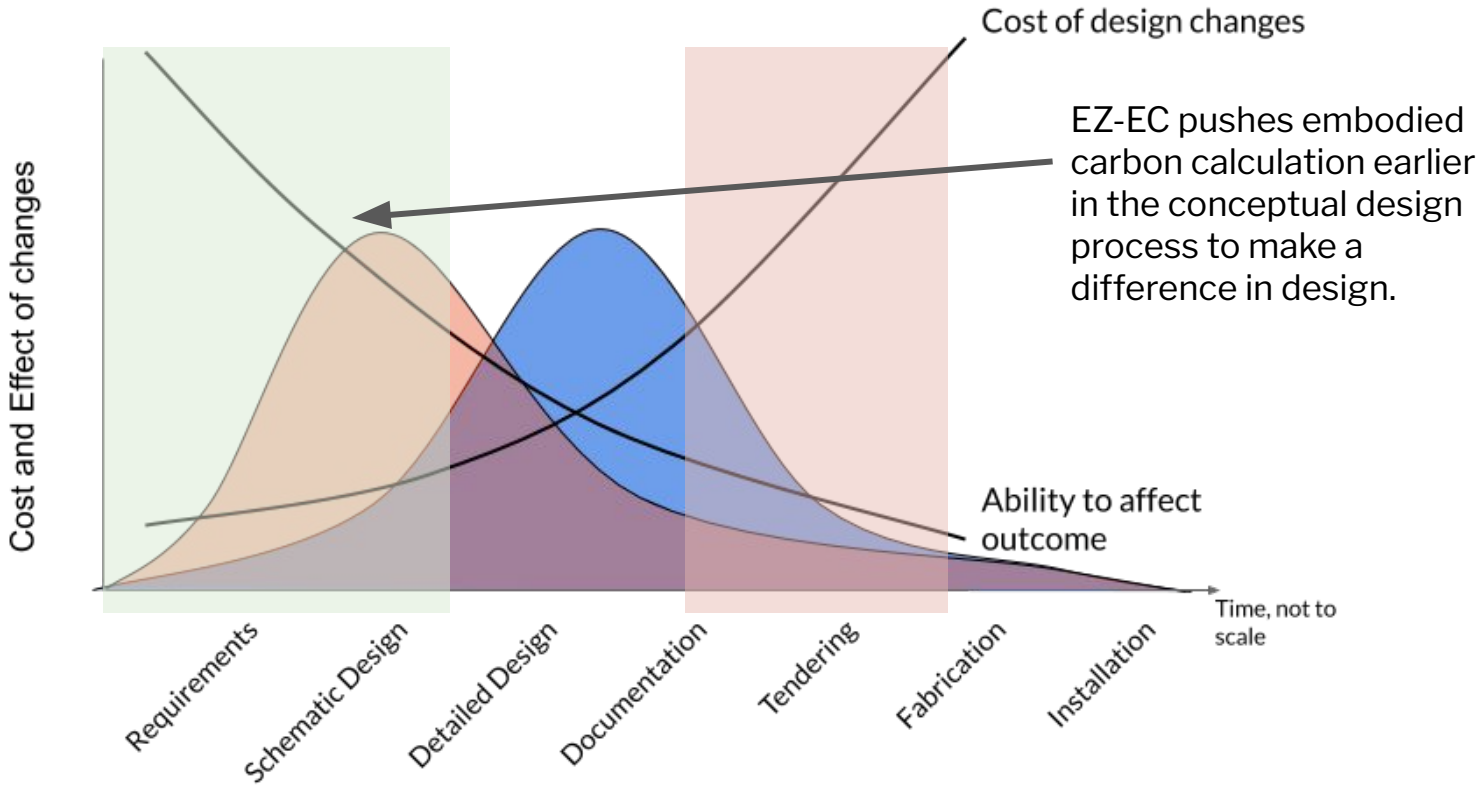
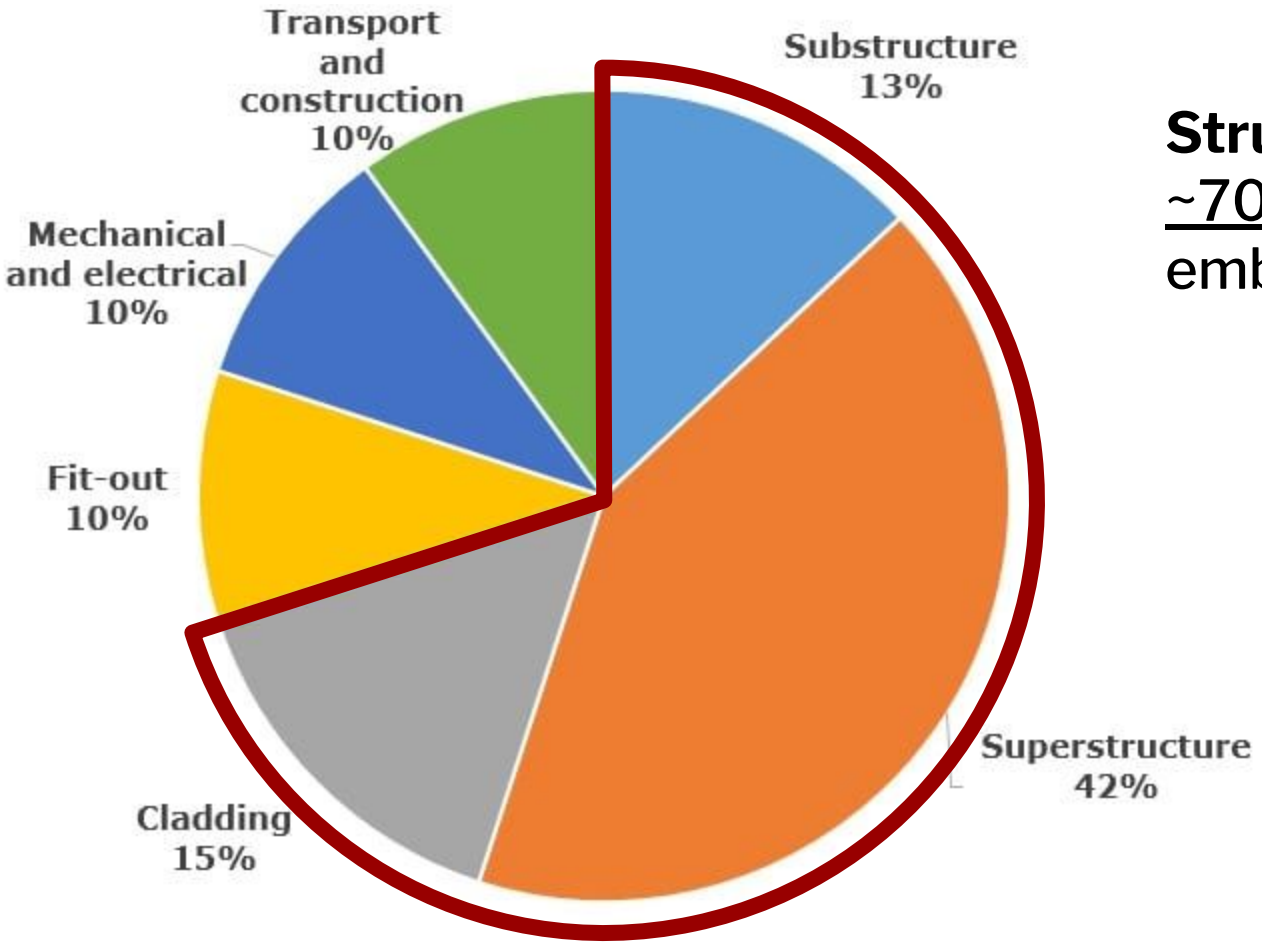


Embodied carbon calculations happen too late in the design process

EC3

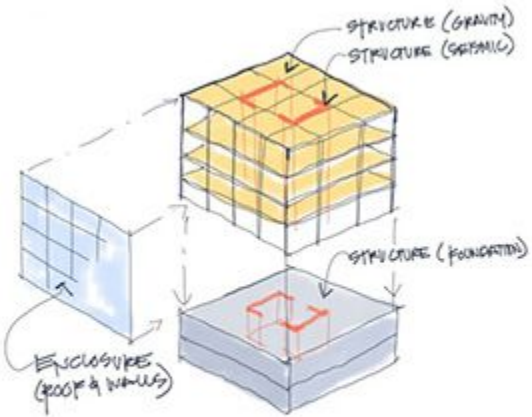



Cost of design changes
EZ-EC pushes embodied carbon calculation earlier in the conceptual design process to make a difference in design.
Cost and Effect of changes
Ability to affect outcome
Time, not to scale
Requirements
Schematic Design
Detailed Design
Documentation
Tendering
Fabrication
Installation



Structure + Facade
~70% of total building embodied carbon

Calculation



MATERIAL QUANTITY ESTIMATE

×

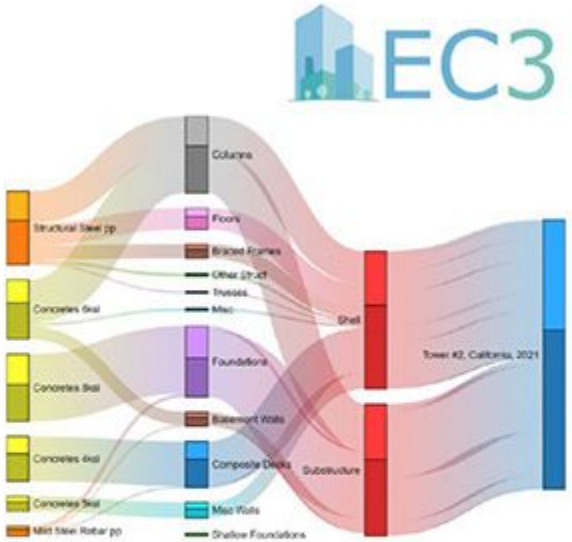
Life Cycle Impact Results (per m³)

Declared Unit: 1 m³ of 10,000 psi concrete at 28 days

OPERATIONAL IMPACTS	PerformX™ PECC10K
Plant Operating Energy (MJ)	38.6
On-Site Plant Fuel Consumption (MJ)	11.1
Concrete Batch Water (m³)	1.68E-01
Concrete Wash Water (m³)	1.91E-02
On-Site Waste Disposal (kg)	0.0
ENVIRONMENTAL IMPACTS	
Total Primary Energy (MJ)	3,017
Climate Change (kg CO_2 eq)	445
Ozone Depletion (kg CFC 11 eq)	1.31E-08
Acidification Air (kg SO_2 eq)	2.96
Eutrophication (kg N eq)	0.09
Photochemical Ozone Creation (kg O_3 eq)	0.61

EMBODIED CARBON PER MATERIAL EPDs

=



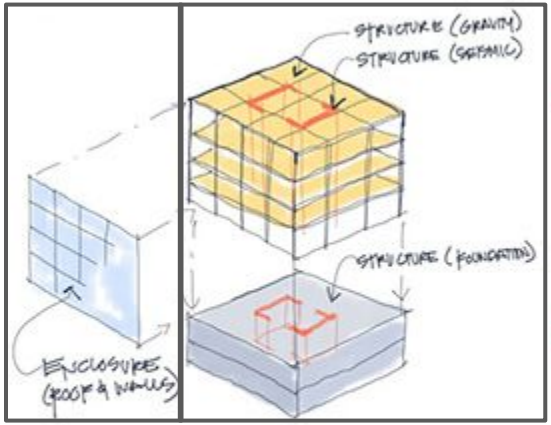
BUILDING EMBODIED CARBON (EC) ESTIMATE

2019

https://buildingtransparency.org/ec3

Calculation

Facade **Structure**



MATERIAL QUANTITY ESTIMATE

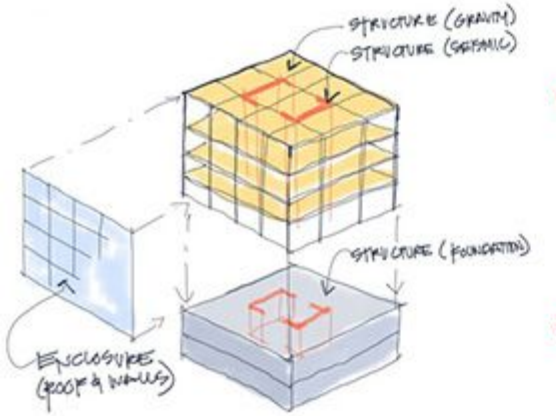
✖

EMBODIED CARBON PER MATERIAL EPDs

=

BUILDING EMBODIED CARBON (EC) ESTIMATE

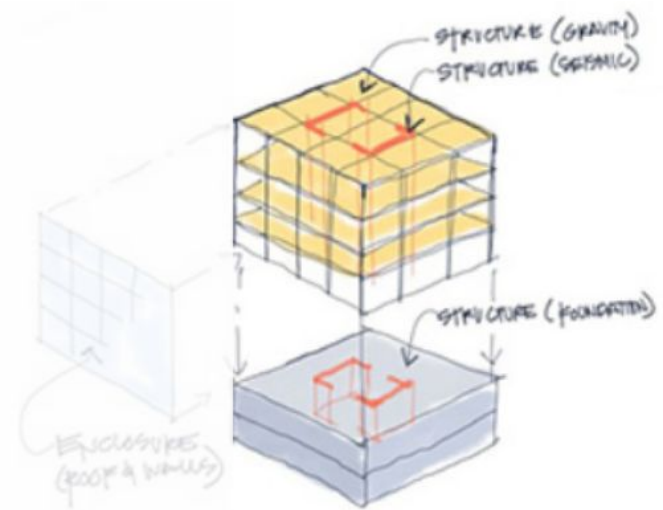
https://buildingtransparency.org/ec3



MATERIAL QUANTITY ESTIMATE

Structure

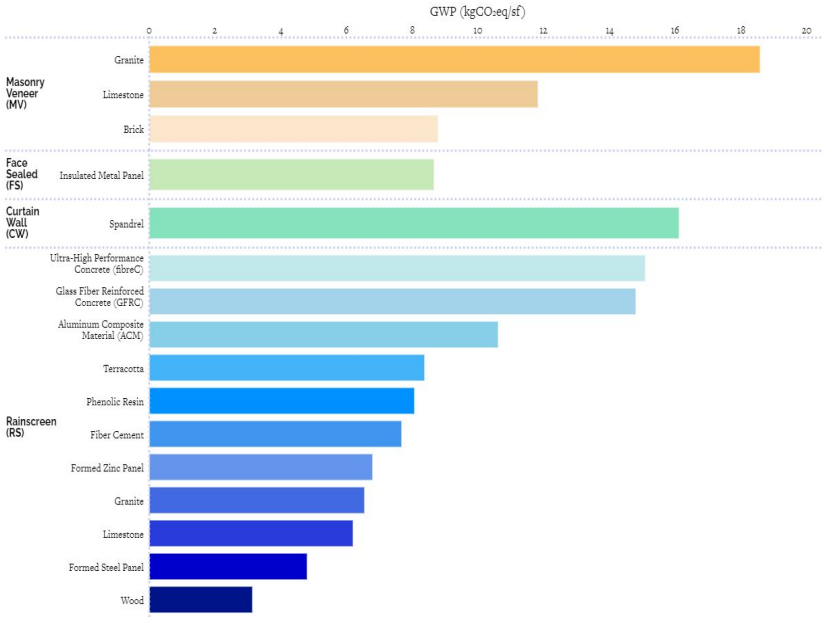

BHoM.
Sustainable Code at Scale
EC3

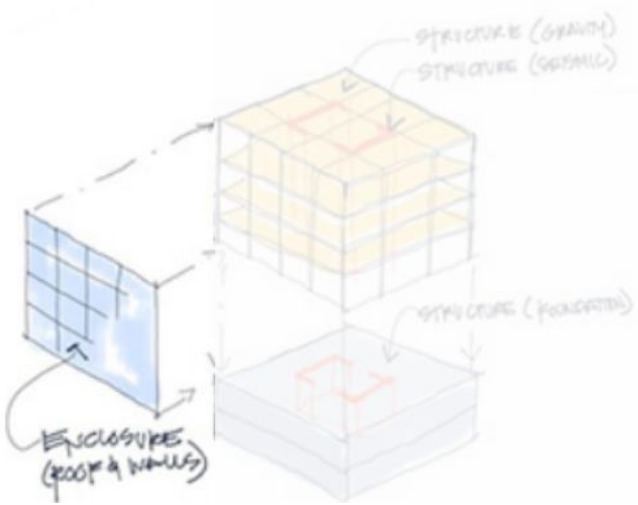

STRUCTURE (GRAVITY)
STRUCTURE (SEISMIC)
STRUCTURE (FOUNDATION)

Kaleidoscope: Embodied Carbon Design Tool

https://www.payette.com/kaleidoscope-tool/

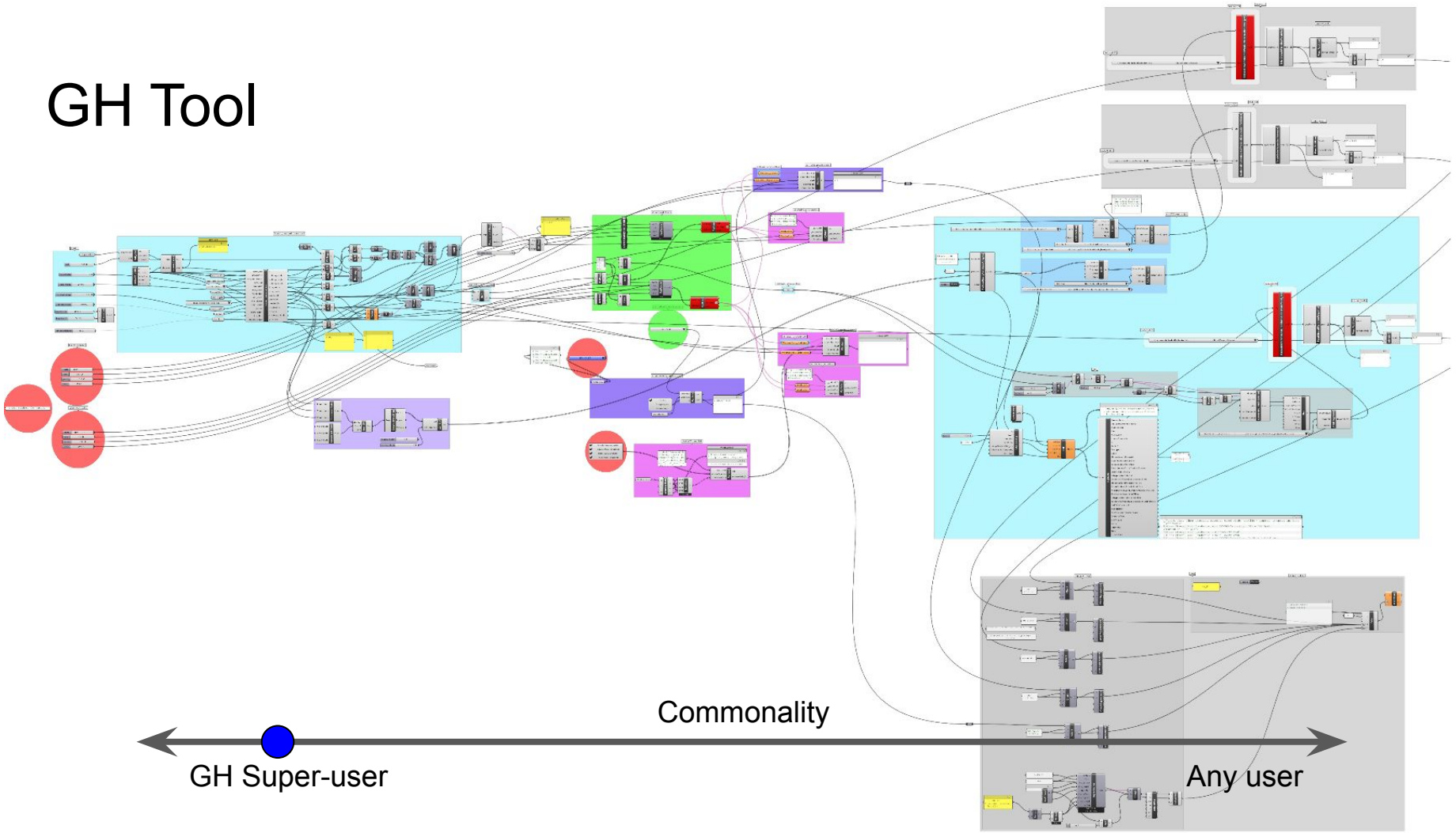
Facade

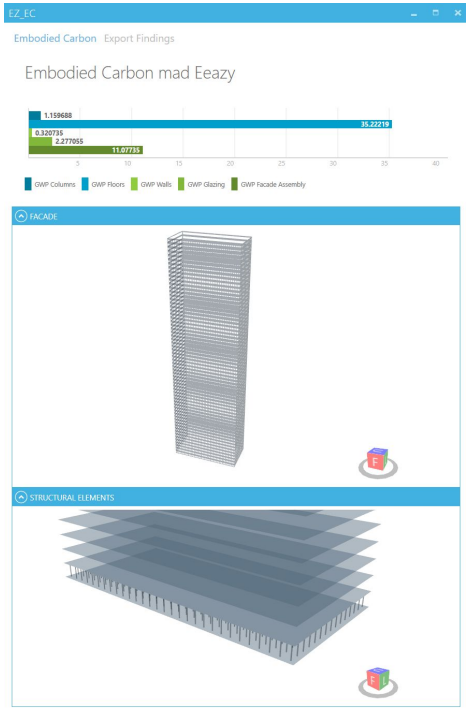




PAYETTE

GH Tool



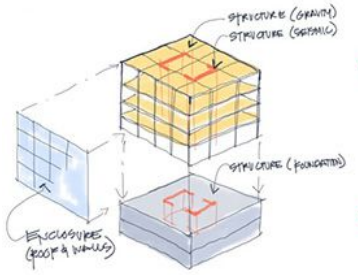


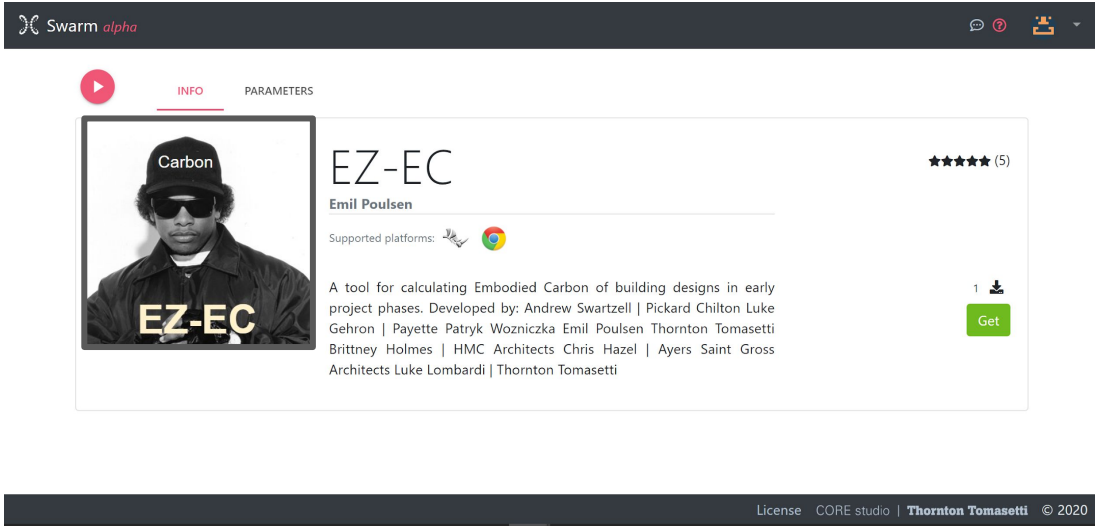
Commonality

GH Super-user

Any user

Concept Model





https://dev-swarm.herokuapp.com/viewer/5f8c6016783c4a000488d0f8

Commonality

GH Super-user

Any user

Cs Swarm: Viewer

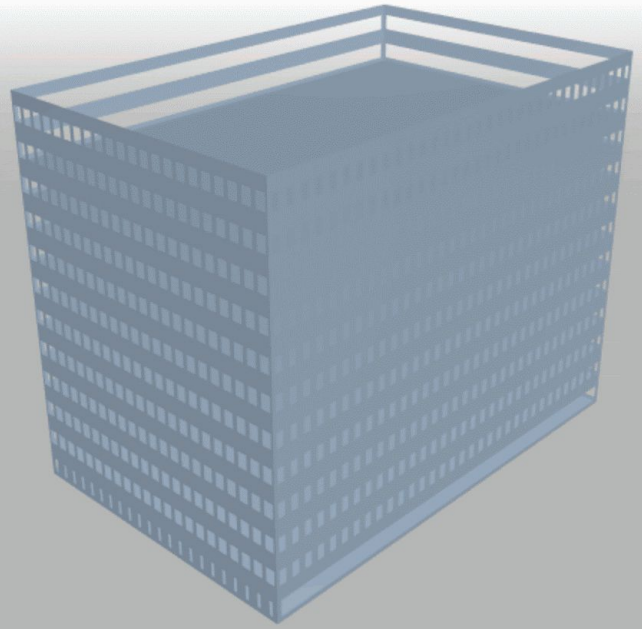
https://dev-swarm.herokuapp.com/viewer/5f8c6016783c4a000488d0f8

Swarm *alpha*

EZ-EZ-05

Inputs

Property Line	CURVE		
FAR	0	20	1.3
Core Width	2	4	4
Lease Depth	35	60	45
Floor to Ceiling	9	10	9
Building Length	150	300	200
Glazing N	0	0.95	0.3
Glazing E	0	0.95	0.22
Glazing S	0	0.95	0.48



Visualization Options

Layers

- Property Line
- Facade surface
- Floor surface

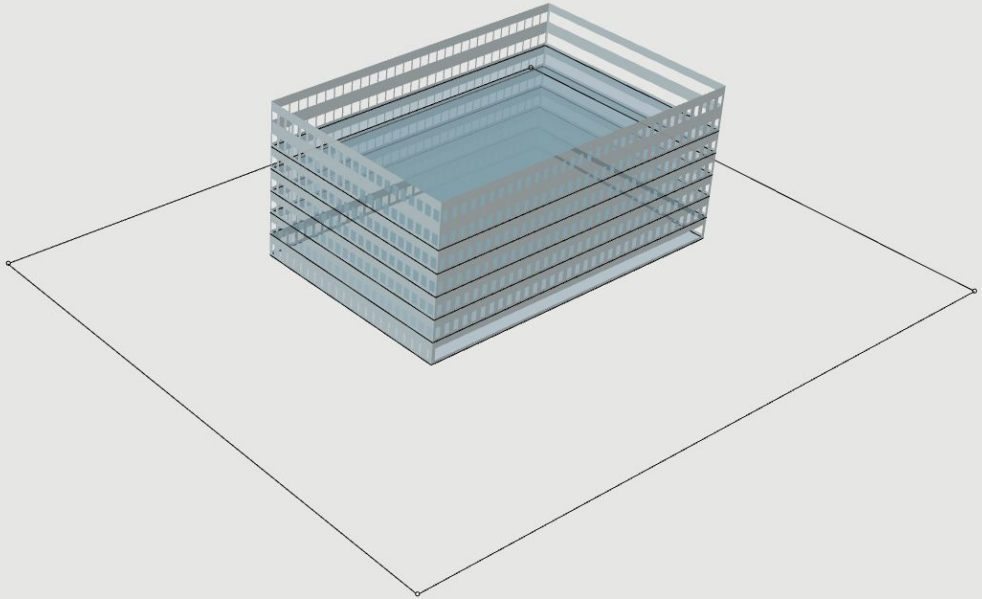
Views

3D

Color by Attribute

Choose a color gradient

swarm



Swarm

0.23.5

EZ-EC-2

Inputs

Property Line 1

FAR: 1.4

0 20

Core Width: 4

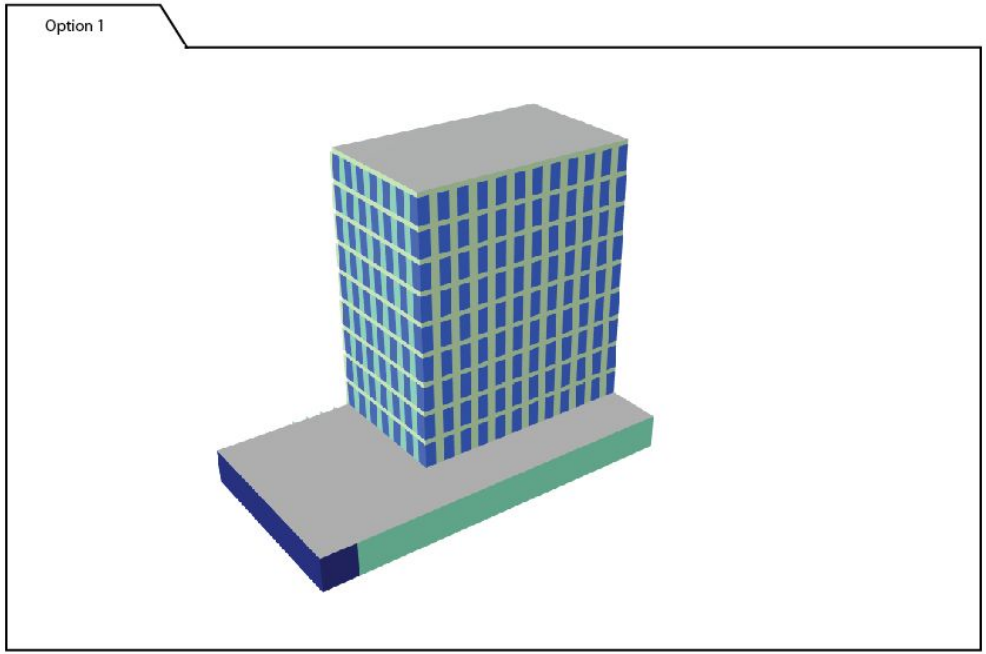
2 4

Lease Depth: 45

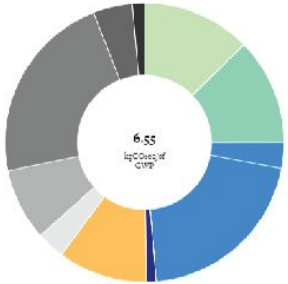
35 60

EMBODIED CARBON MODEL DESIGNER

Designed at the 2020 Virtual AEC Tech Hackathon



Site Width	400'
Site Length	220'
Building Setback	12'
# Floors	15
FAR	0.64
Window Ratio	80%
Structure	Concrete
Facade1	Brick
Facade 2	Metal Panel
Glazing	Alum. Frame



DOWNLOAD RHINO FILE

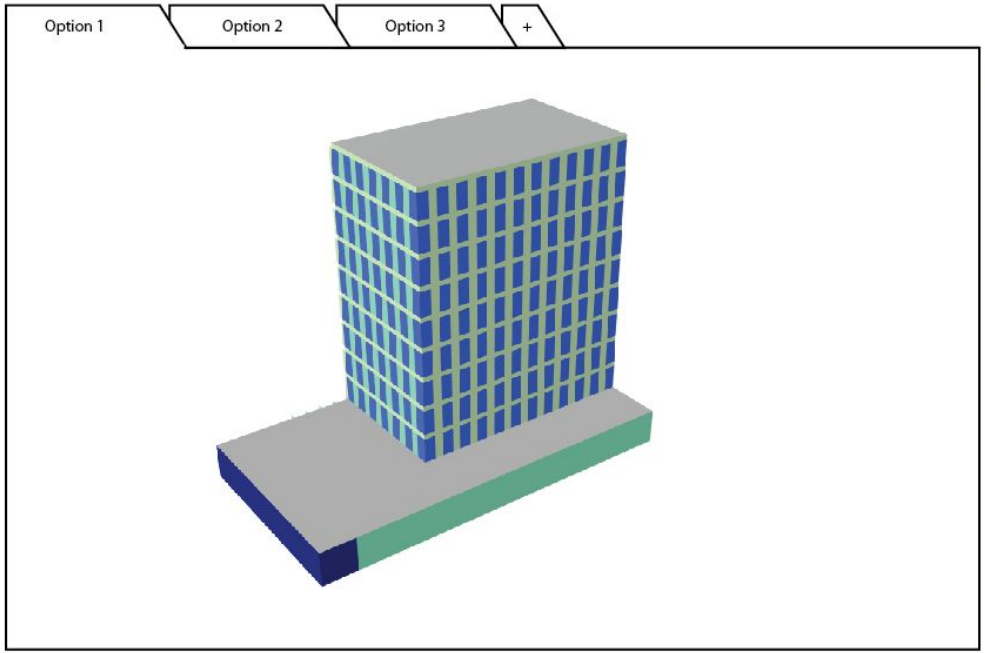
Commonality

GH Super-user

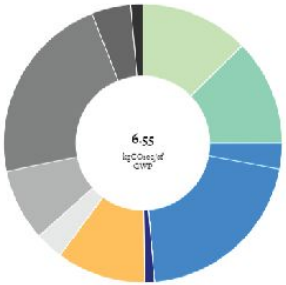
Any user

EMBODIED CARBON MODEL VIEWER

Designed at the 2020 Virtual AEC Tech Hackathon



	Facade 1	MV - Brick
	Facade 2	FS - Metal Panel
	Glazing 1	CW - Alumn. Frame
	Glazing 2	CW - Frit Glass
	Glazing 3	CW - Low E
	Foundation 1	Concrete
	Slab 1	Concrete
	Slab 2	CLT
	Column 1	Concrete
	Beam 1	Steel



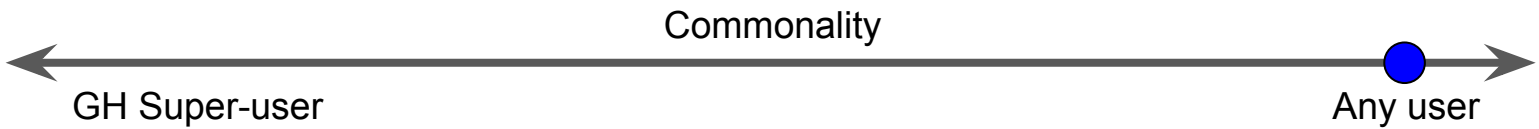
UPLOAD RHINO FILE

Commonality

GH Super-user

Any user

https://lukegehron.github.io/EZ-EC/tool/



Commonality

GH Super-user

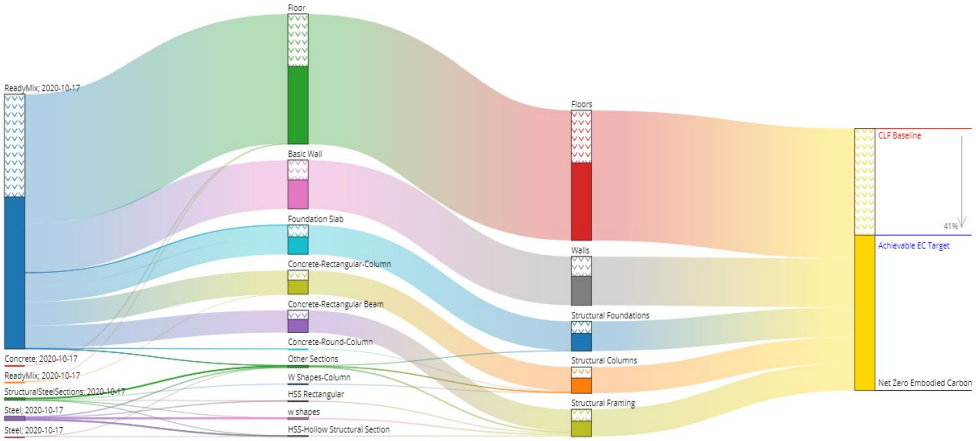
Any user

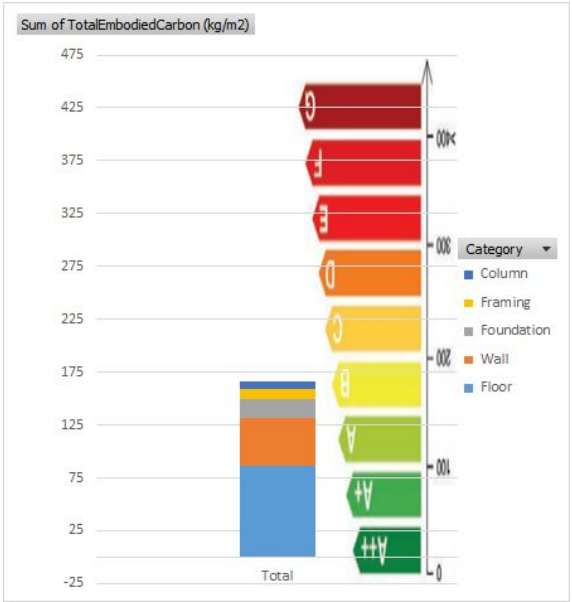
Future Additions

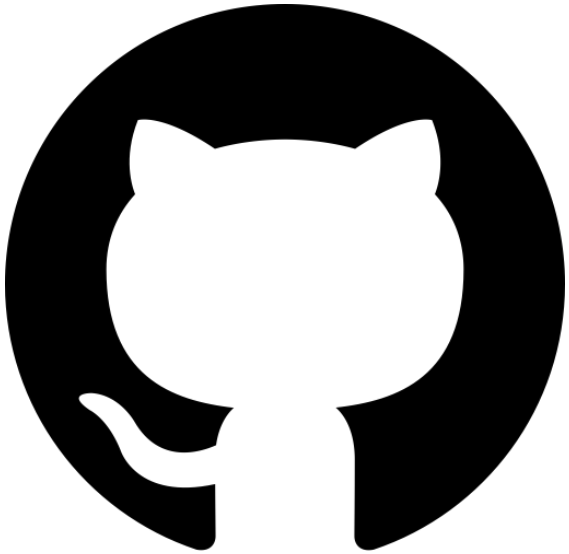
Quick comparisons of structural systems at early concept: steel vs concrete vs timber

Compare design studies with algorithmically generated baseline models

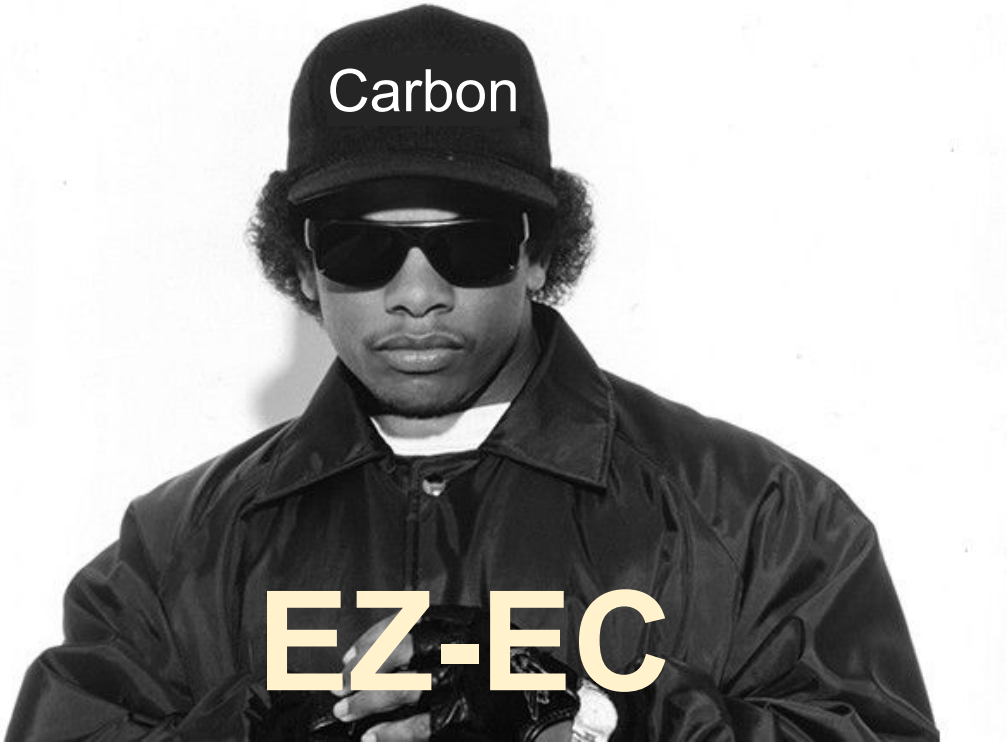
Grade assigned based on EC standards







https://github.com/lukegehron/EZ-EC


Carbon
EZ-EC