EXPANDING THE SCOPE OF CARBON ACCOUNTING FOR PROJECTS

Energy Trust of Oregon
Net Zero Emerging Leaders Internship

Courtney Sigloh

SALAZARCHITECT inc

AN OVERVIEW OF MY EXPERIENCE:

BY THE NUMBERS

12 weeks

3 BIG TASKS

1 team

1. DDx Reporting
2. LCA Reporting
3. Info-graphic

cove.tool

AIA

tally™ ENVIRONMENTAL IMPACT TOOL

CARBON IMPACT
BY PROJECT COMPONENT

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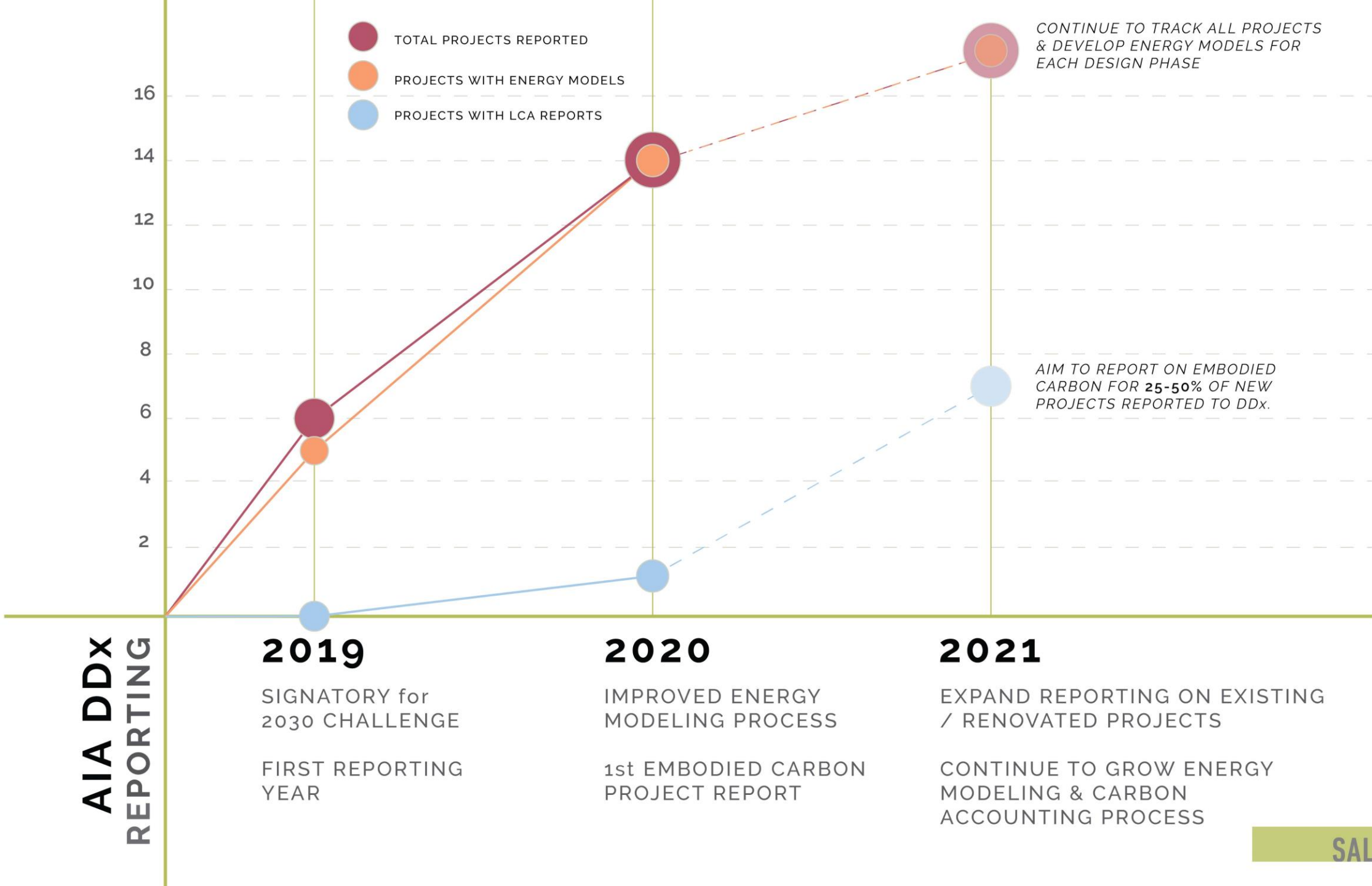
1. DDx Reporting & Cove.Tool Energy Modeling



AIA DDx REPORTING

2019

SIGNATORY for 2030 CHALLENGE

FIRST REPORTING YEAR

2020

IMPROVED ENERGY MODELING PROCESS

1st EMBODIED CARBON PROJECT REPORT

2021

EXPAND REPORTING ON EXISTING / RENOVATED PROJECTS

CONTINUE TO GROW ENERGY MODELING & CARBON ACCOUNTING PROCESS

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A FOCUSED APPROACH

TRACKING & REPORTING 4 PROJECTS

Goldcrest Apartments	Williams Plaza Apartments	Aldercrest Apartments	Maple Lane Apartments
»New Construction	»Renovation of Existing 1972 Building	»Renovation of Existing 1970 Buildings	»New Construction
»82,000 sqft / 75 Units	»Redesigned Site & Interiors	»New Community Building & Landscaping	»Net Zero Ready
»Embodied Carbon WBLCA	**»Tracking Reduction in EUI & Reporting for Renos**	**»Community Building Design Strategies (Passive Design)**	**»Using Cove.Tool for Comparisons & Optimization**

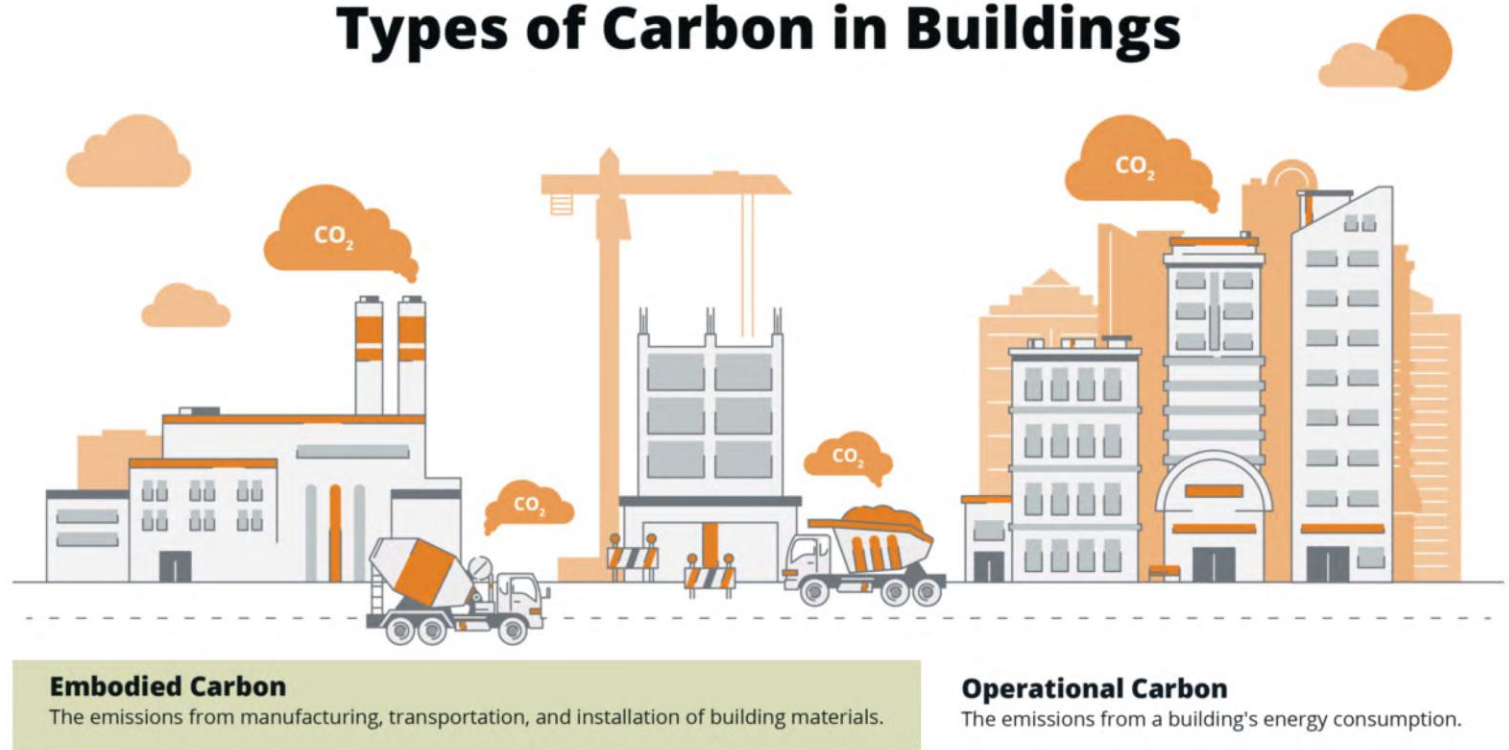
2. Investigating Embodied Carbon: Research, Tools, Process

EMBODIED CARBON ACCOUNTING:

WHAT IS IT?

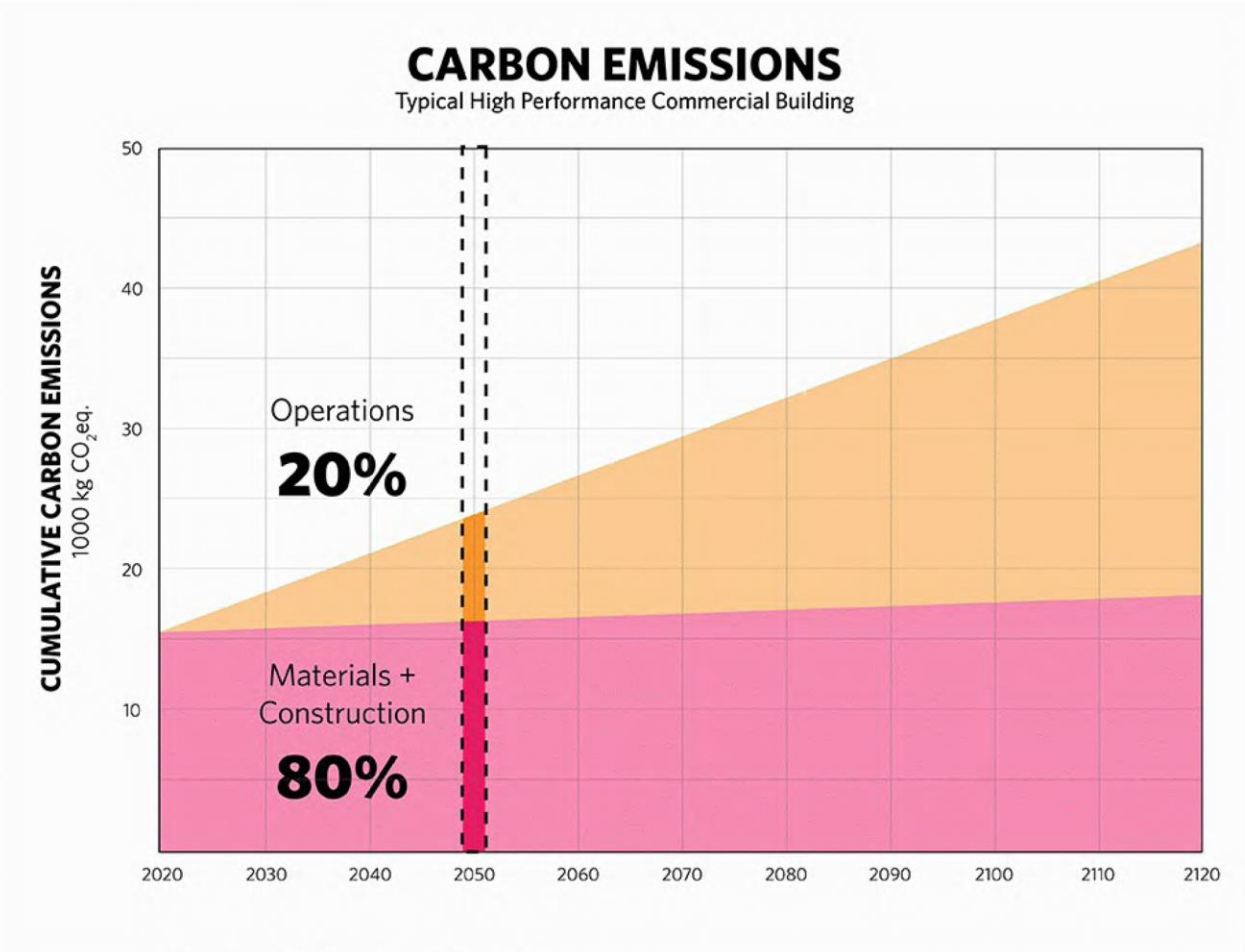
EMBODIED CARBON IS THE TOTAL CARBON EMISSIONS FROM BUILDINGS' PRODUCTS - THEIR TRANSPORT, MAINTENANCE, & END OF LIFE.

EMBODIED CARBON IS THE FIRST STEP IN REDUCING A BUILDING'S CARBON FOOTPRINT



EMBODIED CARBON ACCOUNTING:

WHY IS IT IMPORTANT?



Kieran Timberlake - Carbon Accounting
https://kierantimberlake.com/files/pages/631/embodied-c.gif?1619060464544

AS OPERATIONAL CARBON IS ADDRESSED, EMBODIED CARBON WILL ACCOUNT FOR A GREATER PERCENTAGE

IT IS ANTICIPATED THAT IT WILL BE RESPONSIBLE FOR **72%** OF THE CARBON EMISSIONS ASSOCIATED WITH NEW BUILDING CONSTRUCTION

SELECTING AN LCA TOOL:

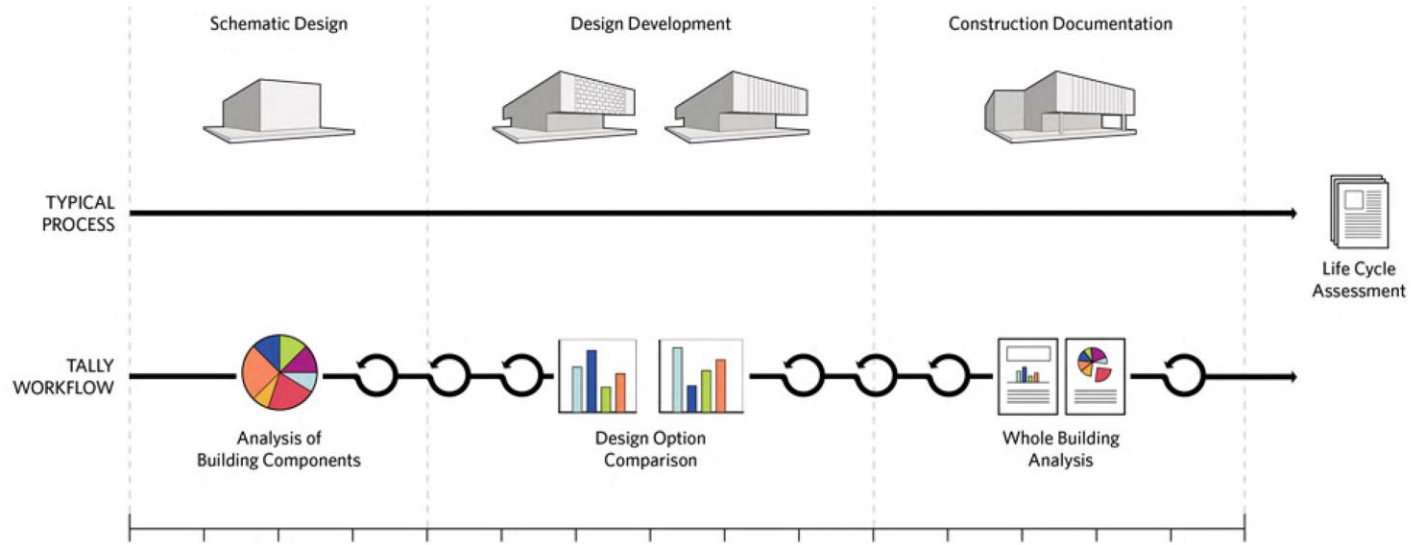
TALLY TOOL (BY KIERAN TIMBERLAKE)

Athena Impact Estimator for Buildings

One Click LCA

Product of Bionova Ltd

tally™ ENVIRONMENTAL IMPACT TOOL



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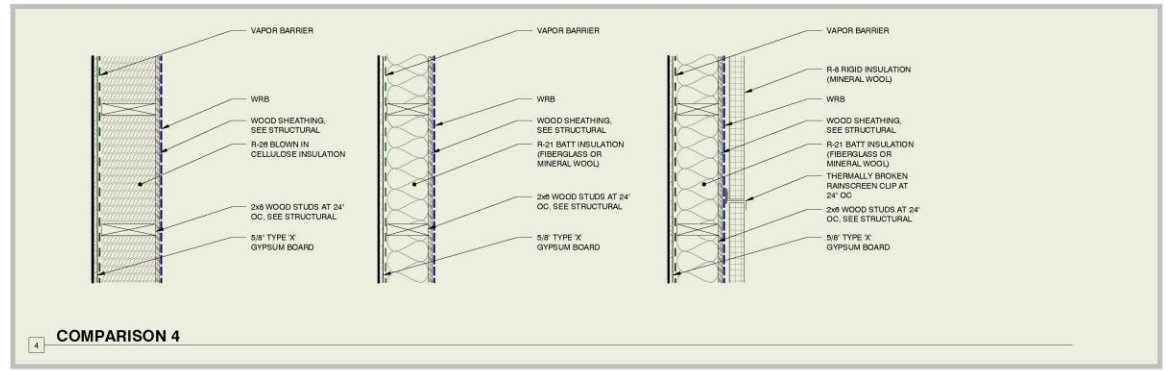
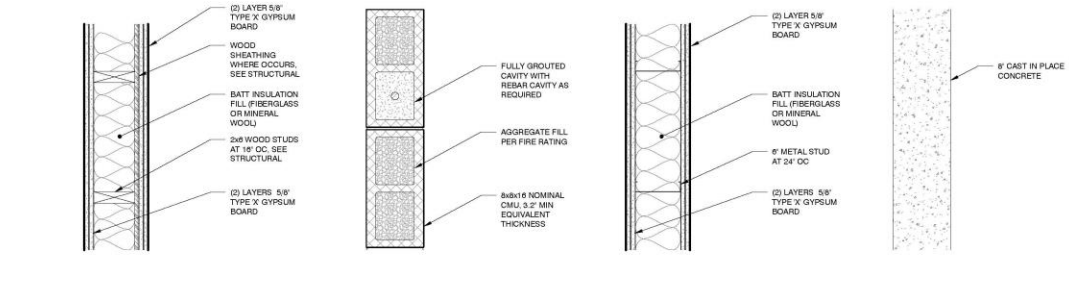
ASSEMBLY COMPARISONS:

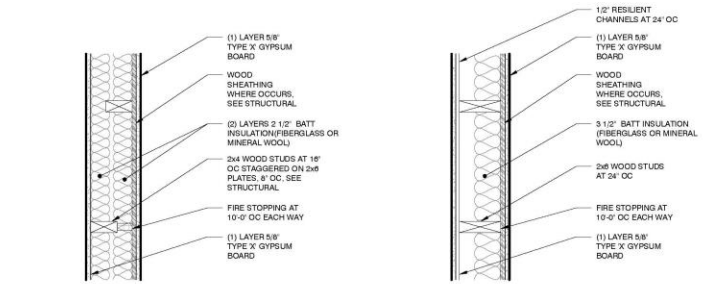
EMBODIED CARBON ANALYSIS

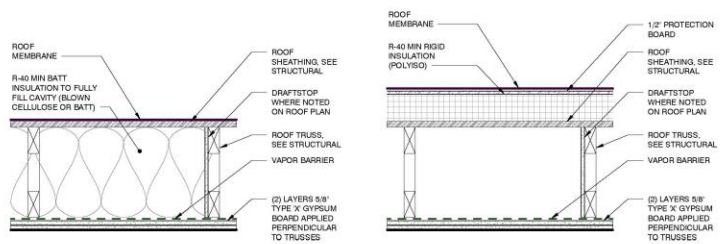
PRIORITIZED GLOBAL WARMING POTENTIAL (GWP) kgCO2eq

UTILIZED THE TALLY DESIGN OPTION COMPARISON TOOL WITH REVIT









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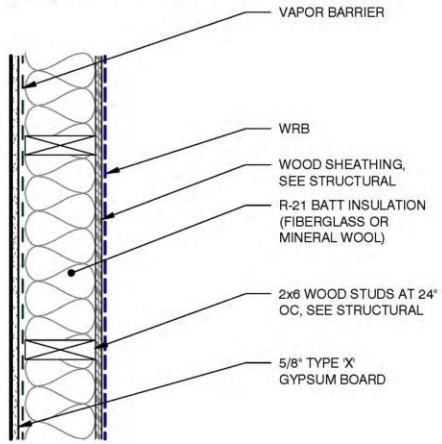
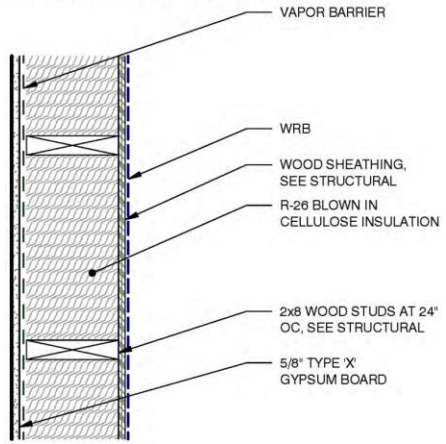
COMPARISON:

Typical Exterior Wall Assemblies

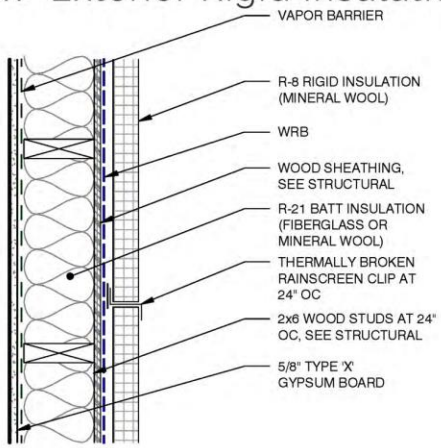
OPTION 1: 2x6 Wood Studs w/ Mineral Wool



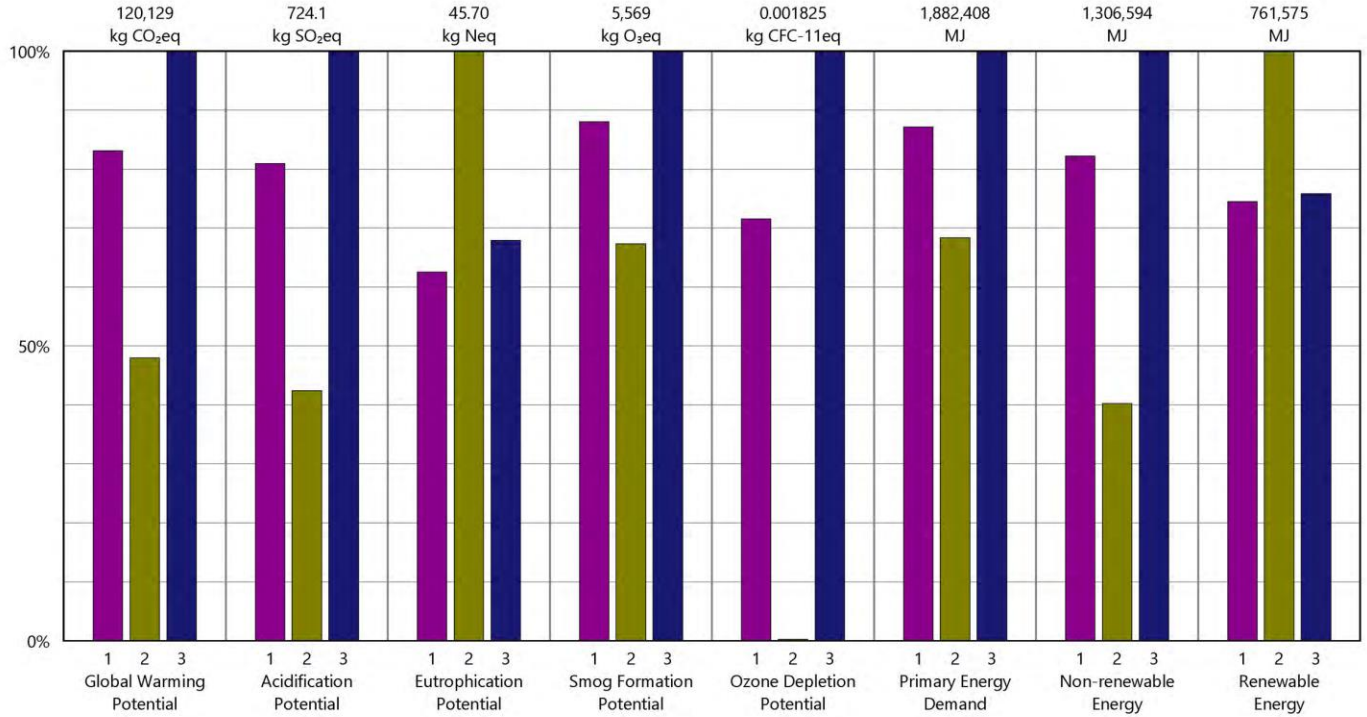
OPTION 2: 2x8 Wood Studs w/ Blown Cellulose



OPTION 3: 2x6 Wood Studs w/ Exterior Rigid Insulation



OPTION 2 SHOWS 35-50% DECREASE IN GWP BUT DOES IT HAVE THE BEST THERMAL PERFORMANCE?



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COMPARISON:

Typical Exterior Wall Assemblies

GWP IMPACT

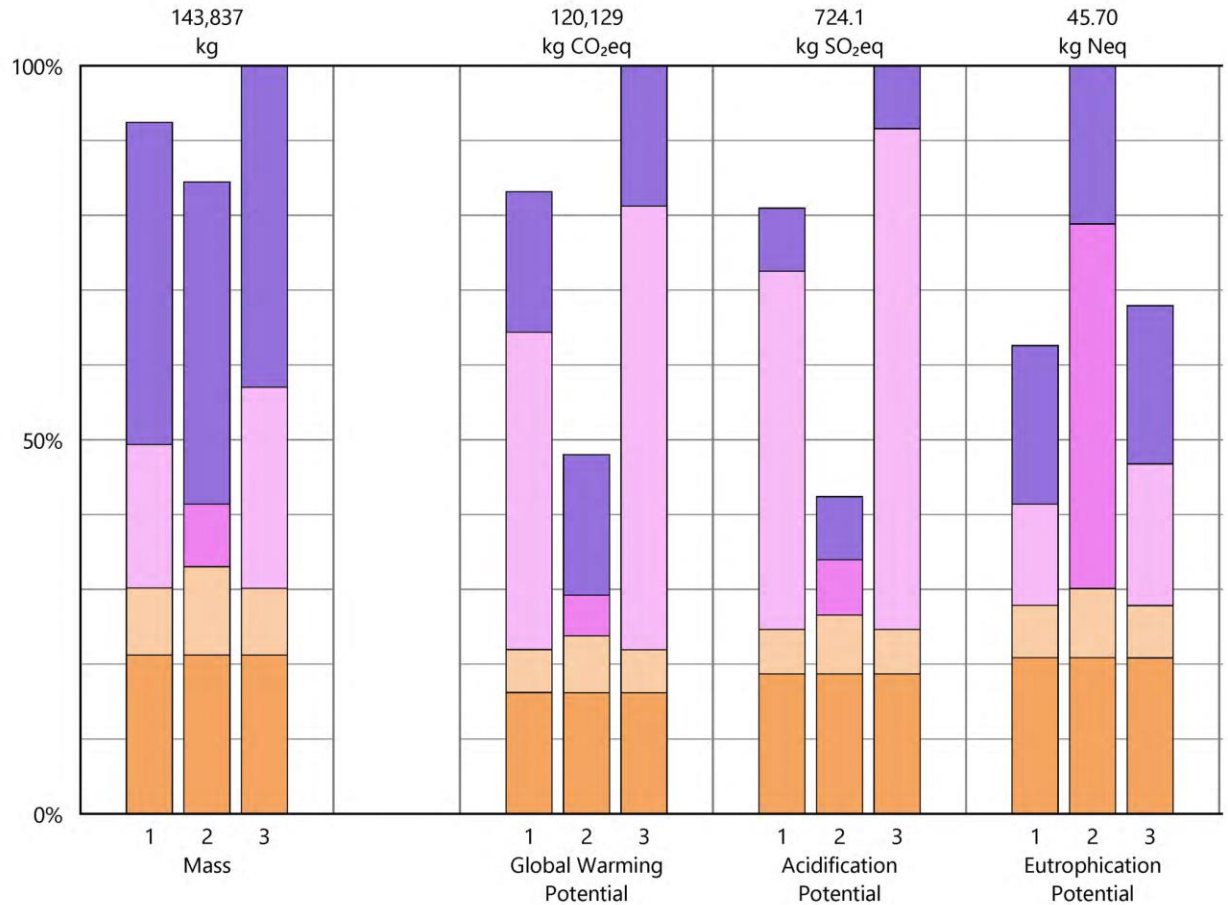
7.25" of Blown Cellulose for R-26

5.5" of Mineral Wool for R-21

06 - Wood/Plastics/Composites
- Plywood, interior grade
- Wood framing

07 - Thermal and Moisture Protection
- Cellulose insulation, blown
- Mineral wool, board, generic

09 - Finishes
- Wall board, gypsum



FUTURE EXPLORATION OF CELLULOSE WITH BEST BLOWING AGENT FOR ENVIRONMENT

OPTION 2 consistently performed better in each of the Environmental Impact Categories - with the exception of Eutrophication Potential. This reminds us to consider the trade-offs of each decision and how performance changes based on categories being assessed.

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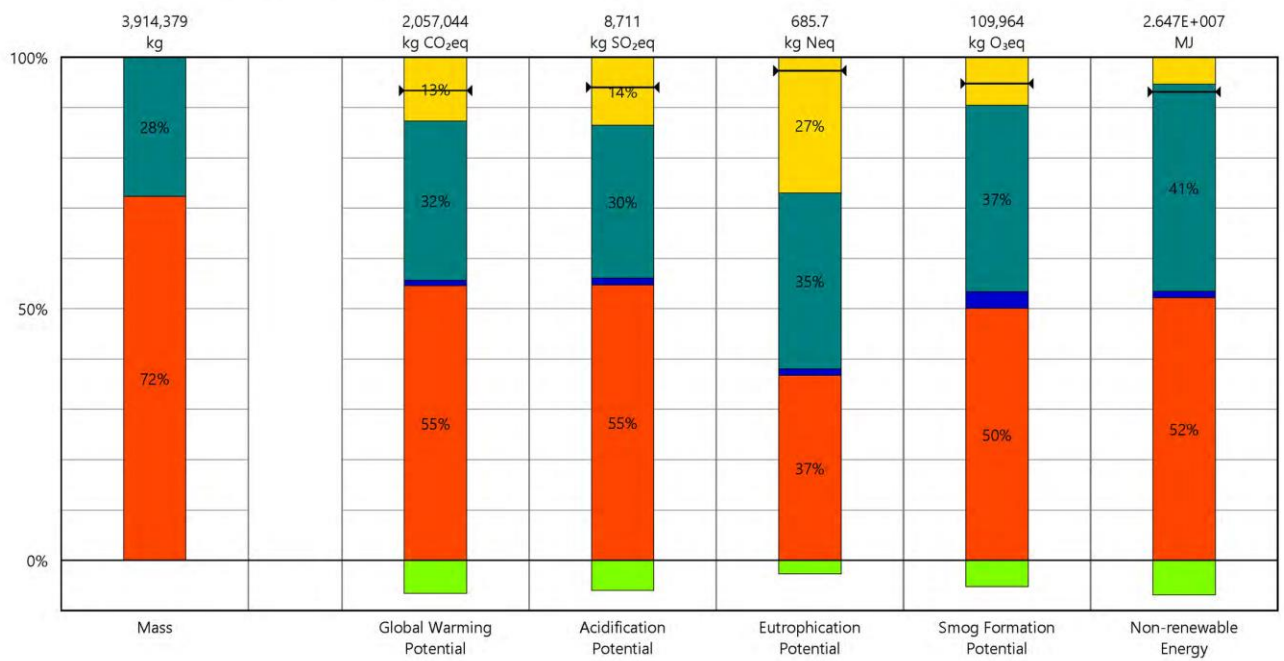
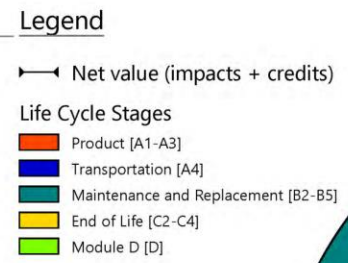
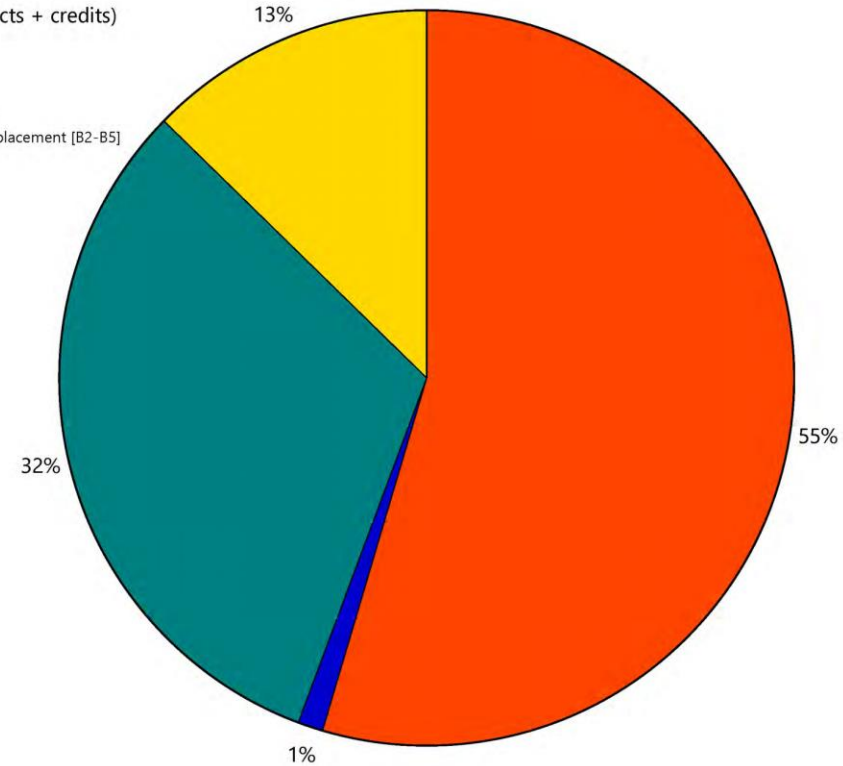
WHOLE BUILDING LCA:

Embodied Carbon Impact for Goldcrest by Life Cycle Stage

Results per Life Cycle Stage







Global Warming Potential

1,920,874 (kg CO_2eq)

GREATEST IMPACT ON GWP COMES FROM PRODUCT SELECTION

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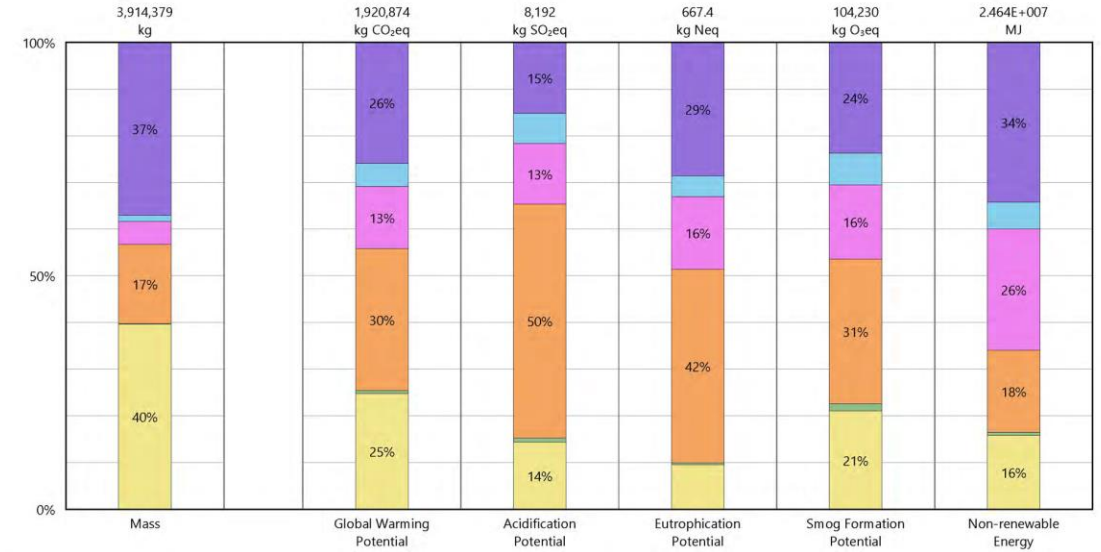
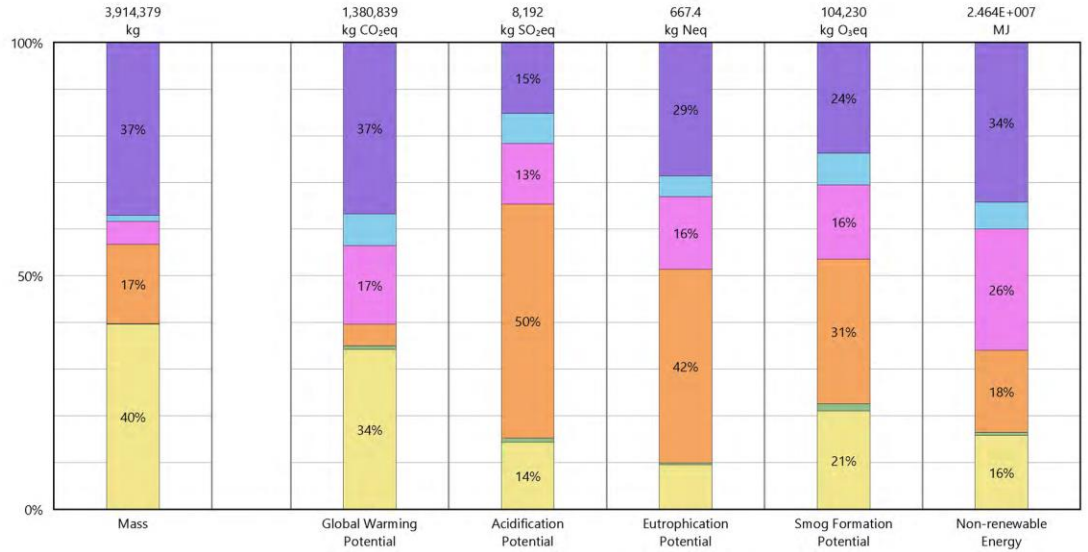
WHOLE BUILDING LCA:

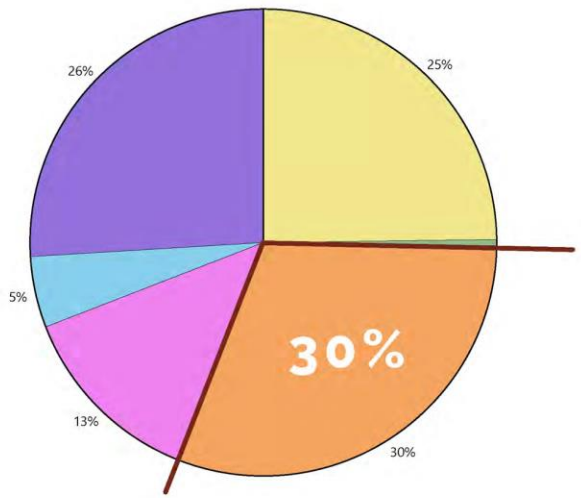
Results per Division -- Not accounting for Biogenic Carbon

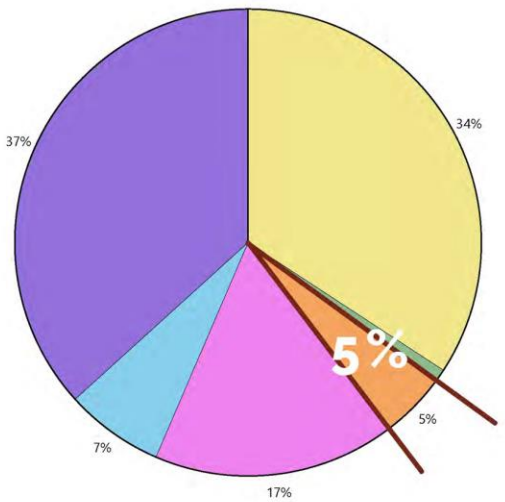


Results per Division -- Includes Biogenic Carbon



Divisions
- 03 - Concrete
- 05 - Metals
- 06 - Wood/Plastics/Composites
- 07 - Thermal and Moisture Protection
- 08 - Openings and Glazing
- 09 - Finishes





Again the question arises:
accounting for biogenic carbon??

When it is not included the wood stud walls account for 30% of the total carbon count - the greatest impact of any division of GWP.

GWP DECREASES FROM 1,920,874 to 1,380,839

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WHOLE BUILDING LCA:

Embodied Carbon Impact for Goldcrest Based on Materials

Legend

03 - Concrete
- Cast-in-place concrete, custom mix
- Cast-in-place concrete, structural concrete, 4001-5000 psi

05 - Metals
- Aluminum, angle
- Aluminum, rectangular tube
- Steel, furring channel

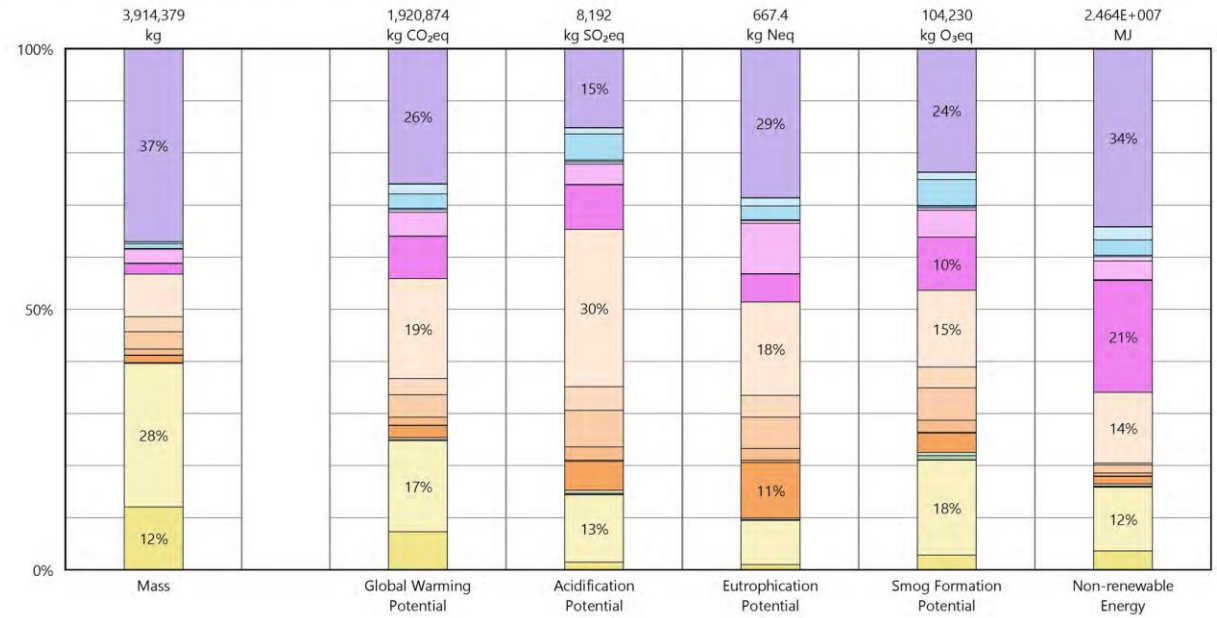
06 - Wood/Plastics/Composites
- Composite wood I-joist
- Laminated veneer lumber (LVL)
- Plywood, exterior grade
- Plywood, interior grade
- Wood framing
- Wood framing with insulation

07 - Thermal and Moisture Protection
- Asphalt roofing shingles
- EPDM, roofing membrane
- Fiber cement panel
- Polyisocyanurate (PIR), board

08 - Openings and Glazing
- Aluminum mullion, inclusive of finish
- Glazing, double pane IGU
- Window frame, vinyl

09 - Finishes
- Acoustic ceiling system, mineral fiber board
- Wall board, gypsum

Results per Division, itemized by Tally Entry



***Footings and foundations (concrete totals) are an estimate in this analysis; in subsequent Tally results this value may change.*

WHAT'S UP WITH GYPSUM? IS THERE AN ALTERNATIVE COMING?

Gypsum Wall Board accounts for 26% of the total embodied carbon in the project!

Gypsum has a huge impact and appears all throughout a multi-family project - with double layers for demising walls.

Lightweight gypsum products with less water in the mix can be used to reduce energy intensity.

Optimize the thickness of gypsum being drawn - get it as thin as possible.

Optimize the interior elevations and carefully dimension relative to gypsum sheet size to limit the amount of wasted material.

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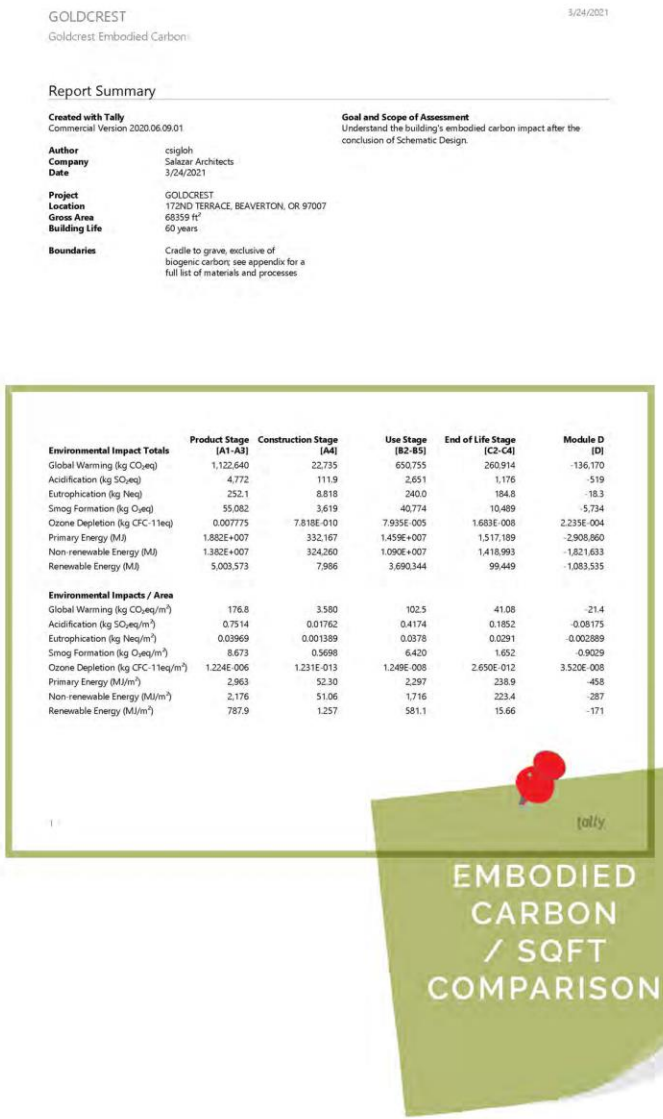
WHOLE BUILDING LCA:

Embodied Carbon Impact Comparison Across Future Projects



GOLDCREST 3/24/2021

Goldcrest Embodied Carbon

Report Summary

Created with Tally
Commercial Version 2020.06.09.01

Goal and Scope of Assessment
Understand the building's embodied carbon impact after the conclusion of Schematic Design.

Author csigloh
Company Salazar Architects
Date 3/24/2021

Project GOLDCREST
Location 172ND TERRACE, BEAVERTON, OR 97007
Gross Area 68359 ft²
Building Life 60 years

Boundaries Cradle to grave, exclusive of biogenic carbon; see appendix for a full list of materials and processes

Environmental Impact Totals	Product Stage [A1-A3]	Construction Stage [A4]	Use Stage [B2-B5]	End of Life Stage [C2-C4]	Module D [D]
Global Warming (kg CO_2eq)	1,122,640	22,735	650,755	260,914	-136,170
Acidification (kg SO_2eq)	4,772	111.9	2,651	1,176	-519
Eutrophication (kg Neq)	252.1	8.818	240.0	184.8	-18.3
Smog Formation (kg O_3eq)	55,082	3,619	40,774	10,489	-5,734
Ozone Depletion (kg CFC-11eq)	0.007775	7.818E-010	7.935E-005	1.683E-008	2.235E-004
Primary Energy (MJ)	1.882E+007	332,167	1.459E+007	1,517,189	-2,908,860
Non-renewable Energy (MJ)	1.382E+007	324,260	1.090E+007	1,418,993	-1,821,633
Renewable Energy (MJ)	5,003,573	7,986	3,690,344	99,449	-1,083,535
Environmental Impacts / Area					
Global Warming (kg CO_2eq/m²)	176.8	3.580	102.5	41.08	-21.4
Acidification (kg SO_2eq/m²)	0.7514	0.01762	0.4174	0.1852	-0.08175
Eutrophication (kg Neq/m²)	0.03969	0.001389	0.0378	0.0291	-0.002889
Smog Formation (kg O_3eq/m²)	8.673	0.5698	6.420	1.652	-0.9029
Ozone Depletion (kg CFC-11eq/m²)	1.224E-006	1.231E-013	1.249E-008	2.650E-012	3.520E-008
Primary Energy (MJ/m²)	2,963	52.30	2,297	238.9	-458
Non-renewable Energy (MJ/m²)	2,176	51.06	1,716	223.4	-287
Renewable Energy (MJ/m²)	787.9	1.257	581.1	15.66	-171

tally

EMBODIED CARBON / SQFT COMPARISON

Environmental Impact Totals	Product Stage [A1-A3]	Construction Stage [A4]	Use Stage [B2-B5]	End of Life Stage [C2-C4]	Module D [D]
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3. Developing an Info-graphic for Client Communication

COMPARISON FOR CLIENTS

A BREAKDOWN OF DESIGN DECISIONS WITH RESPECT TO EMBODIED CARBON, COST, AND DIFFICULTLY.

BALANCING SUSTAINABLE DESIGN WITH BUDGET & SCHEDULE RESTRAINTS ASSOCIATED WITH MULTI-FAMILY HOUSING.

DISCUSS SUSTAINABLE DESIGN OPTIONS EARLY ON

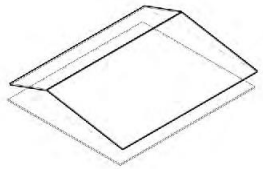
CARBON IMPACT
BY PROJECT COMPONENT

SALAZARCHITECT inc

$ $ COST

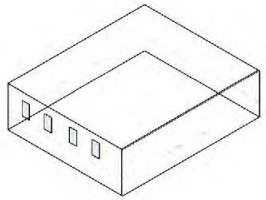
EMBODIED CARBON

DIFFICULTY



ROOF

●	$$$	STANDING SEAM METAL ROOF
●	$	ASPHALT SHINGLES
■	$$	THERMOPLASTIC ROOF MEMBRANE PVC - MORE DURABLE, MORE EXPENSIVE TPO - MORE FLEXIBLE, MORE AFFORDABLE

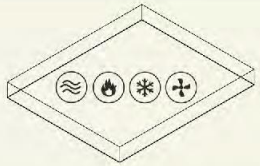


ENVELOPE

■	$	ADV. WOOD FRAMING
●	$$	METAL RAIN SCREEN SIDING
■	$$	SPEC. LOW CARBON INSUALTIONS BLOWN CELLULOSE FIBERGLASS BATT SHEEP'S WOOL

WINDOWS

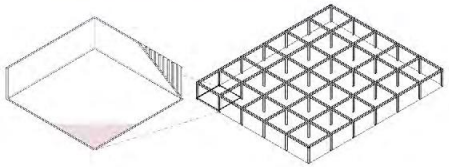
ALUMINUM FRAMED	●	$$
VINYL FRAMED	●	$
WOOD FRAMED	●	$$$



SYSTEMS

●	$	PRIORITIZE PASSIVE DESIGN STRATEGIES
■	$$$	INCLUDE RENEWABLE ENERGY SYSTEMS
■	$$	HIGH EFFICIENCY SYSTEMS

OPERATIONAL CARBON



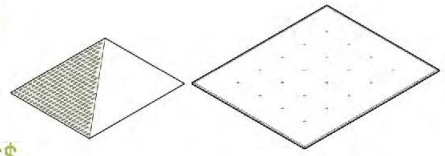
GREATEST % OF EMBODIED CARBON

STRUCTURE

■	$$$	FSC CERTIFIED WOOD STRUCTURE (OVER PODIUM)
●	$$	STANDARD STEEL FRAMING OVER PODIUM
■	$$	REDUCE CONCRETE & STEEL WHERE ABLE RECYCLED STEEL CONCRETE WITH HIGH % FLY ASH

THE UNIT

USE EXPOSED STRUCTURE AS FLOOR FINISH	◆	$
LIGHTWEIGHT & THIN GYPSUM	■	$$
NYLON CARPET TILES SOLUTION-DYED RECYCLED CONTENT	●	$$$

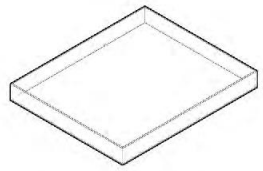


SLAB

■	$	USE EXISTING BUILDING SLAB
■	$	REDUCE BUILDING FOOTPRINT
●	$$	HOLLOW CORE CONCRETE SLAB w/ STEEL REINFORCEMENT (TYP.)

PARKING

TYPICAL CONCRETE PARKING LOT	●	$
PERMEABLE PAVERS (REDUCED CEMENT)	●	$$$
REDUCE PARKING SQFT DEVELOP ON-STREET PARKING SHARE EXISTING PARKING LOTS	■	$$



BASEMENT

●	$	ELIMINATE BASEMENT WHEN POSSIBLE
■	$$	REDUCE SQFT OF BASEMENT
◆	$$$	PARKING BENEATH BUILDING

Looking Back to Move Forward: Reflections & Next Steps

OPERATIONAL CARBON vs EMBODIED CARBON:

HOW TO QUANTIFY AND TRACK?

Dana Fradon, *The New Yorker* May 17, 1976
Credit: Dana Fradon/The New Yorker Collection/The Cartoon Bank

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REFLECTIONS:

MAJOR TAKE AWAYS & LESSONS LEARNED

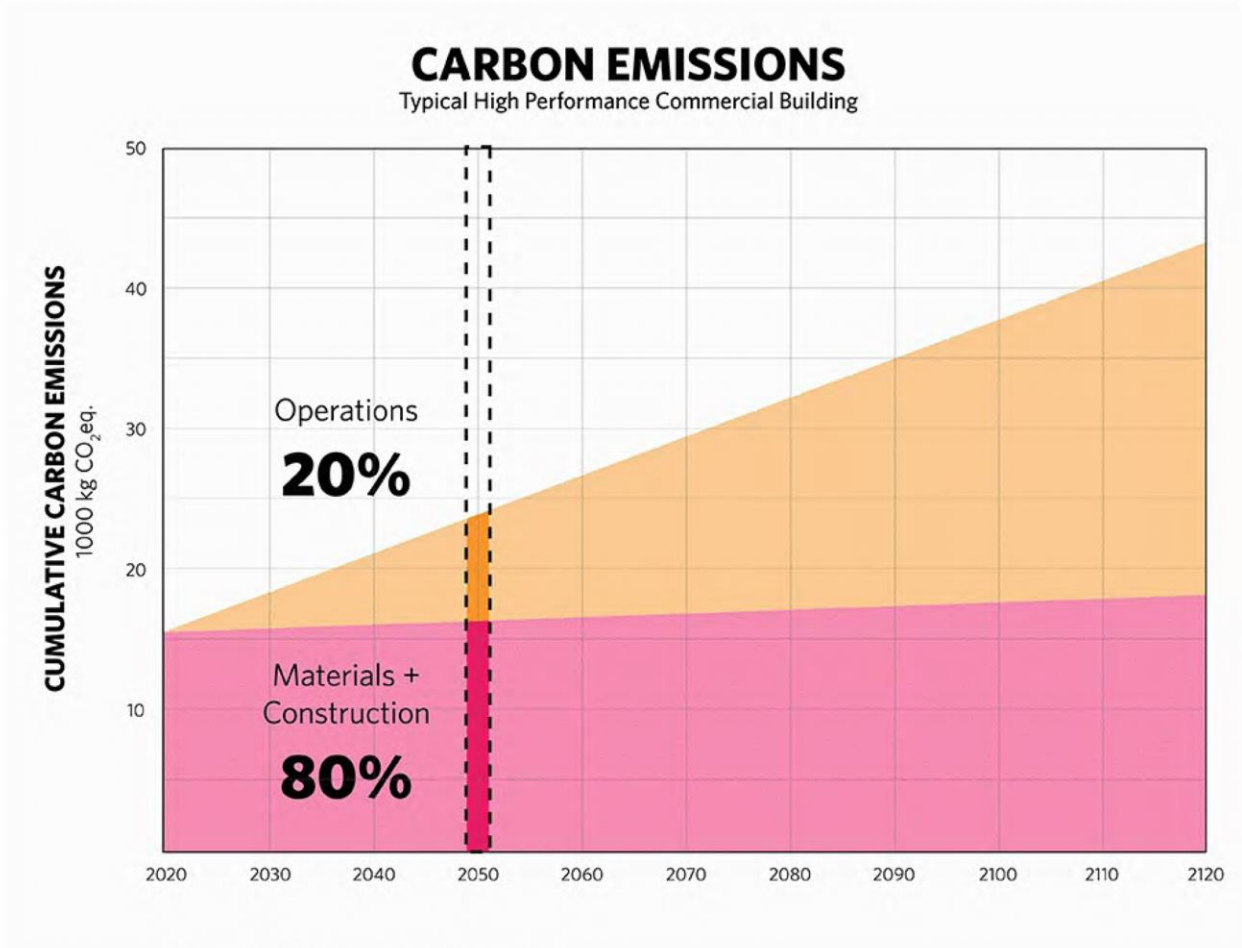
» UP UNTIL THIS POINT, **OPERATIONAL CARBON** HAS BEEN **PRIORITIZED IN BUILDING SUSTAINABILITY**

» **EMBODIED CARBON** NEEDS TO BE AN **EQUAL OR GREATER FACTOR** IN BUILDING DECISIONS

» EMBODIED CARBON IS A **DIRECT RESPONSIBILITY FOR ARCHITECTS - MATERIALS!**

» ONCE EMBODIED CARBON HAS BEEN POURED INTO OUR PROJECTS - **THERE IS NO GOING BACK**

» **POLICY & ENERGY CODES** NEED TO EXPAND TO INCLUDE EMBODIED CARBON DECISIONS



Kieran Timberlake - Carbon Accounting
https://kierantimberlake.com/files/pages/631/embodied-c.gif?1619060464544

LOOKING AHEAD:

NEXT STEPS FOR CARBON ACCOUNTING...

IS THE BEST BUILDING NO BUILDING?

IS OUR BEST FOOT FORWARD USING AN EXISTING BUILDING?

HOW DO YOU QUANTIFY THE TRADE OFF BETWEEN A LESS OPERATIONALLY EFFICIENT "OLD" BUILDING AND A NEW, NET ZERO BUILDING?

HOW MUCH CARBON IS SPARED BY USING AN EXISTING BUILDING?

Williams Plaza Apartments - Portland, Oregon
Renovated Project by Salazar Architects

SALAZARCHITECT inc

THANK YOU!

Expanding the Scope of Carbon Accounting for Projects
Net Zero Emerging Leaders Internship

Courtney Sigloh - cysigloh5k@gmail.com

April 29th, 2021

SALAZARCHITECT inc