Evolving Data Driven Lab Design

Carbon Reduction & Benchmarking: Programming Carbon

This session delivers data-driven insights for solving the pressing problems research organizations are facing: outdated facilities, underutilized space, high investment for low return, and meeting regulatory and compliance requirements. Session leaders demonstrate the analysis processes that identify opportunities and drive smarter decisions for moving forward, inspiring innovative planning and operational solutions, and unlocking the potential of both new facilities or renovations. They illustrate methods for overcoming data challenges, mining and synthesizing large data sets, visualizing and planning scenarios for the future, and implementing long term facility data management systems.

I2SL 2025 – Evolving Data Driven Lab Design

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Perkins&Will

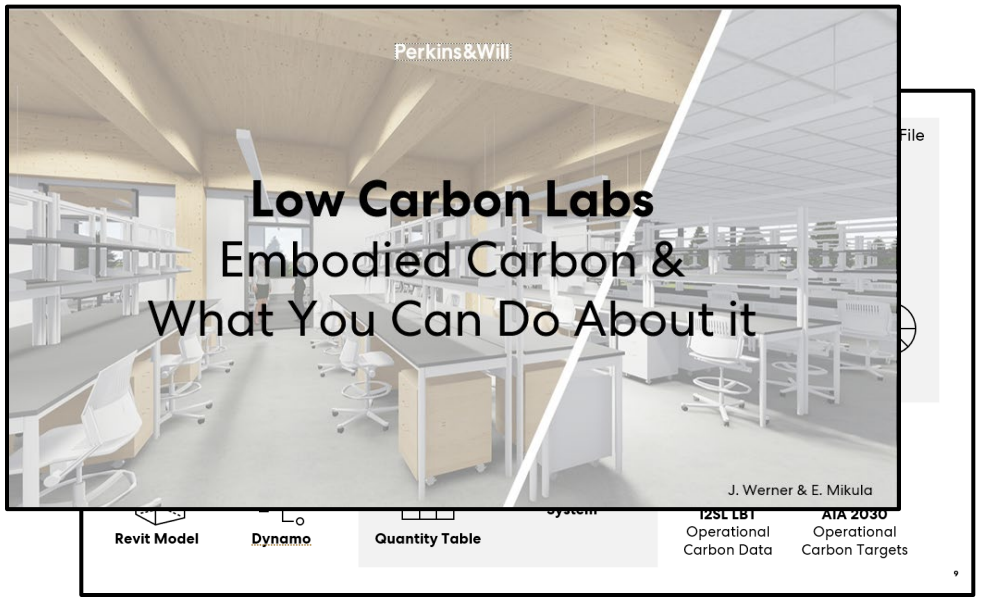
Learning Objectives

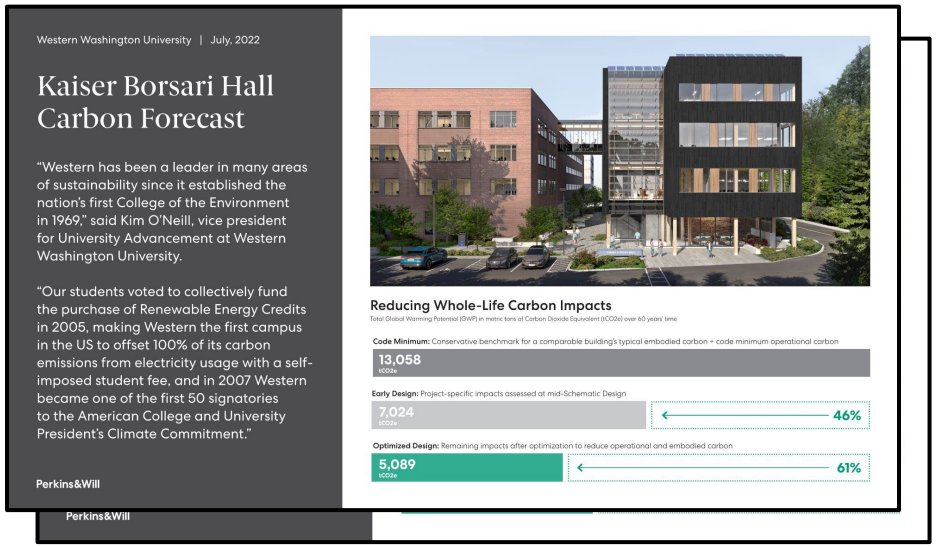
1. Challenge the potential for decarbonizing lab facilities during the Programming phase of design, before wholesale LCA are typically complete.

2. Identify the potentials and challenges of carbon reduction strategies targeting Program selections.

3. Understand the need for accurate modeling and data mining from models, even at the Programming stage of a project.

I2SL 2022 – Low Carbon Labs





https://research.perkinswill.com/projects/low -carbon -labs/

Previously - I2SL 2022/2023 – Low Carbon Labs

Barnard College

R&D Science Center

PROJECT

Existing Campus Building + Addition to expand Sciences at Barnard

Multidisciplinary Science Center

Research & Teaching Labs

SCOPE

Major Renovation + New Addition

Highrise – 14 stories

85,000 NSF

100 Fumehoods

GOALS

LEED Gold

Support larger campus goals

Local Law 97

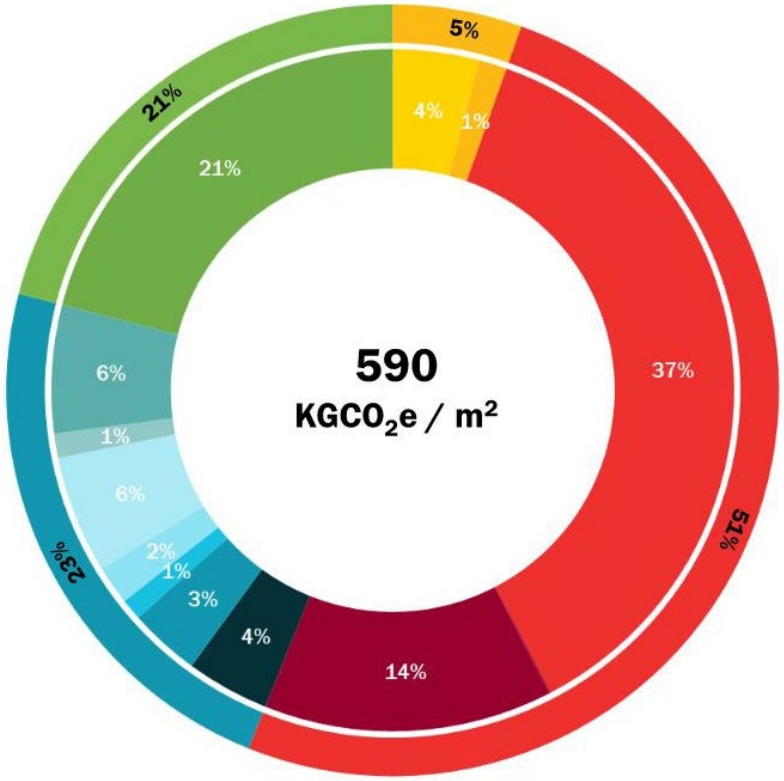
Circular Economy

INNOVATION

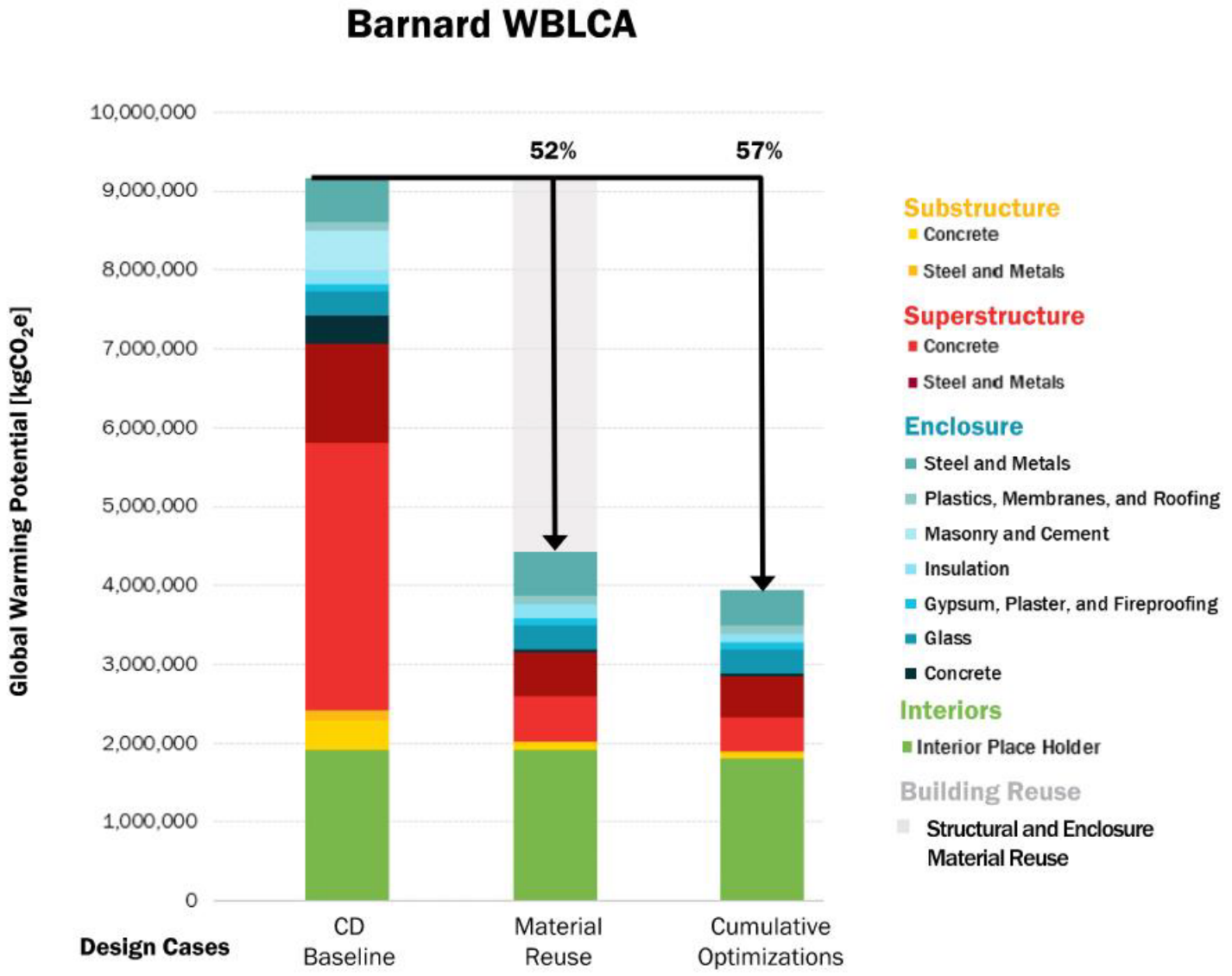
Adaptive Re-use

All Electric Building

Whole Building Life Cycle Assessment



Baseline Characterization Plot



I2SL 2022 – Low Carbon Labs

Heating: all new gas-fired condensing boilers; hot water system.

Cooling: all new high efficiency modular centrifugal magnetic bearing chillers; chilled water system

Heat rejection: all new cooling towers

Ventilation: 100% fresh air to all spaces supplied by dedicated outside air units at the roof; ventilation rates as per EH&S and NYC code

Exhaust: VAV and specific exhaust for each utility; lab exhaust is cannon-type variable volume control; Lab fume hood fans are cannon-type variable extractor control

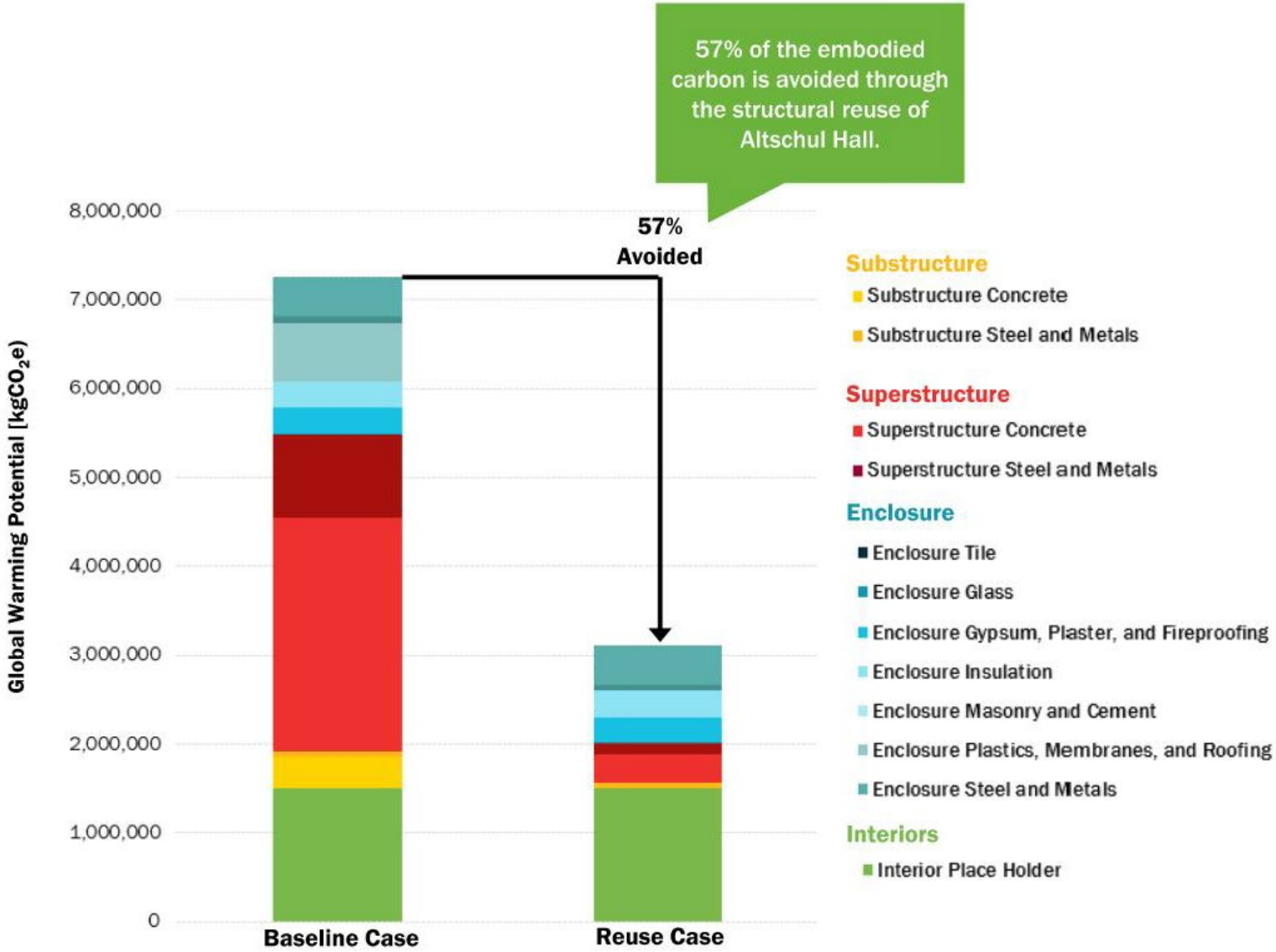
Energy Recovery: variable air volume AHUs in MERs, heat recovery chiller

Distribution: VAV with reheat; perimeter radiation

Space controls: space thermostats for all shared occupancy spaces, offices have shared controls (3-4 offices per zone)

Metering: design to meet LEED credit, meter all major energy end uses

A high performance, state of the art system that can be converted to an all-electric system in the future.



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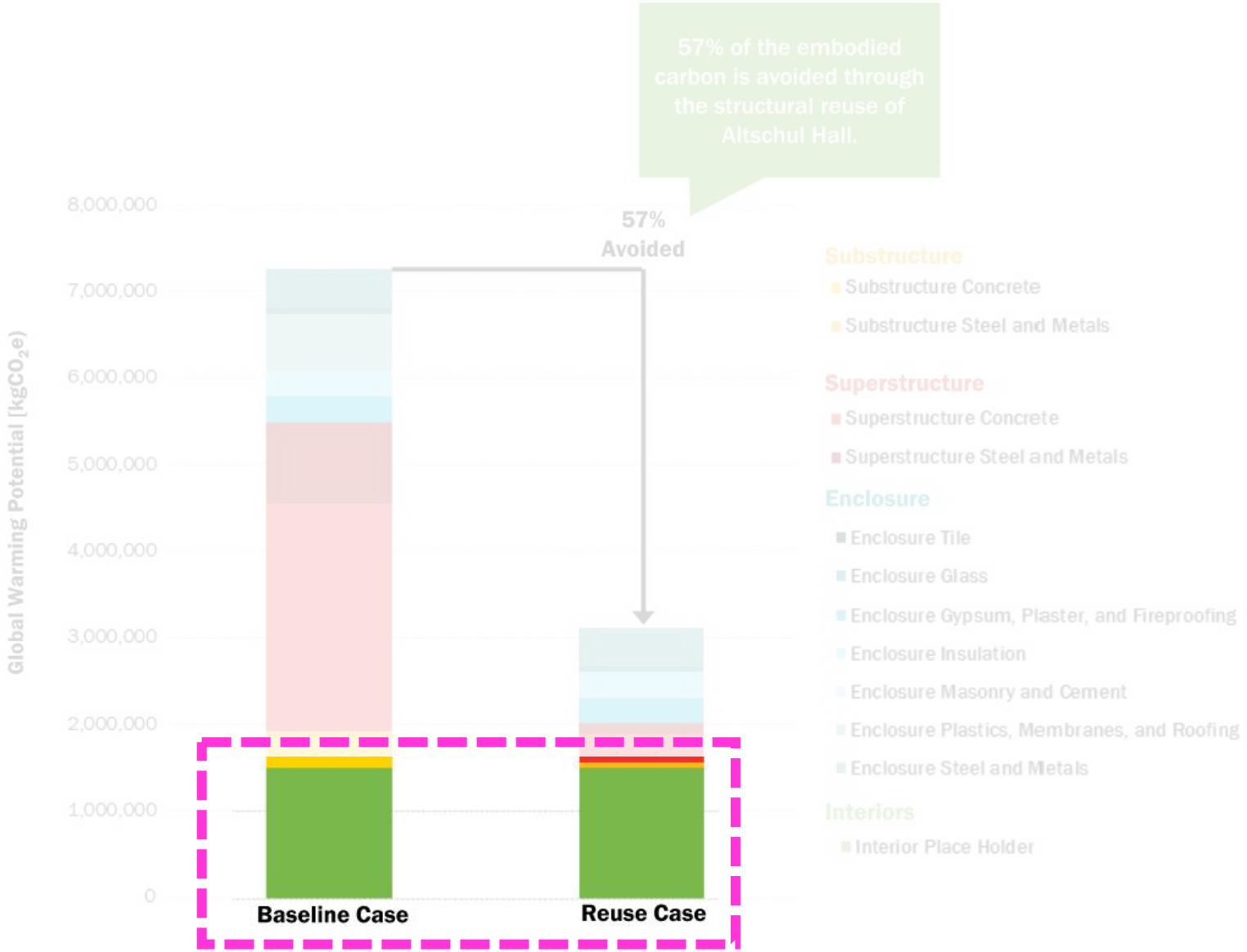

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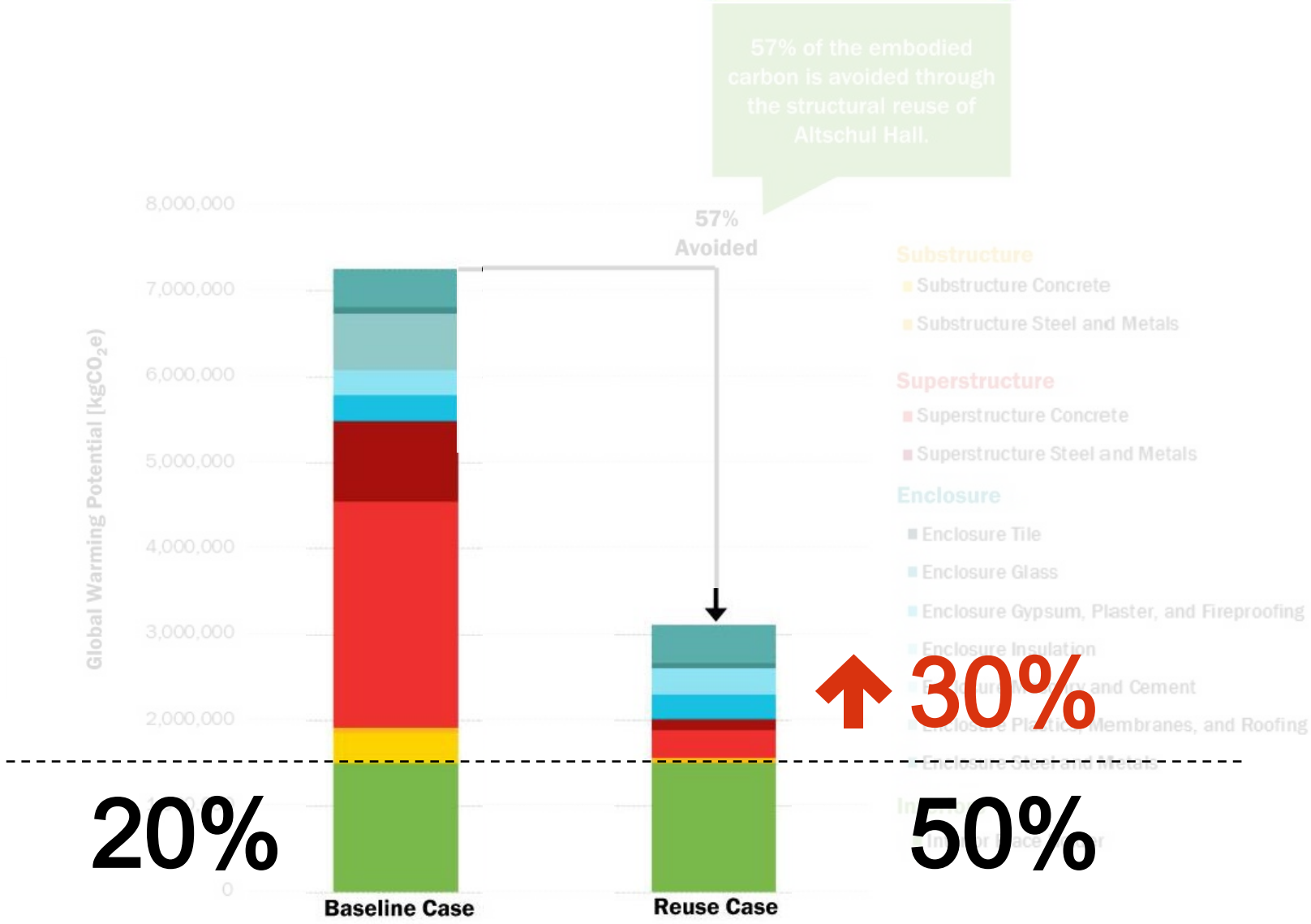
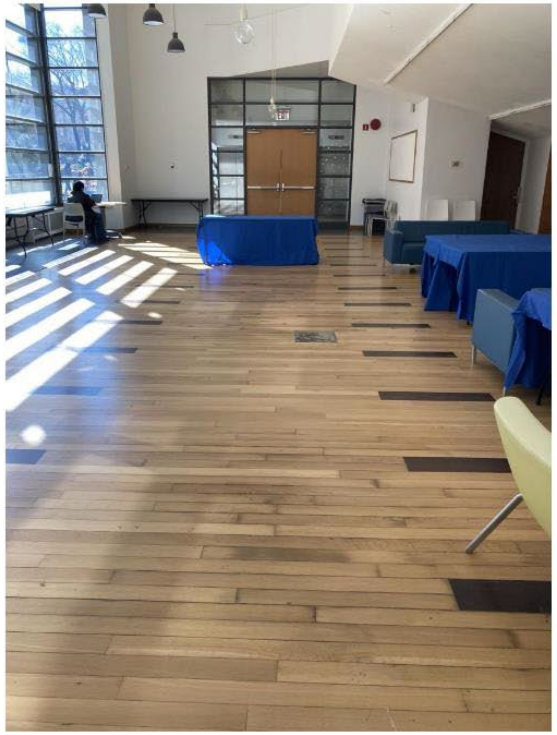


Material Reuse at Gateway

Reuse of Altschul Elements



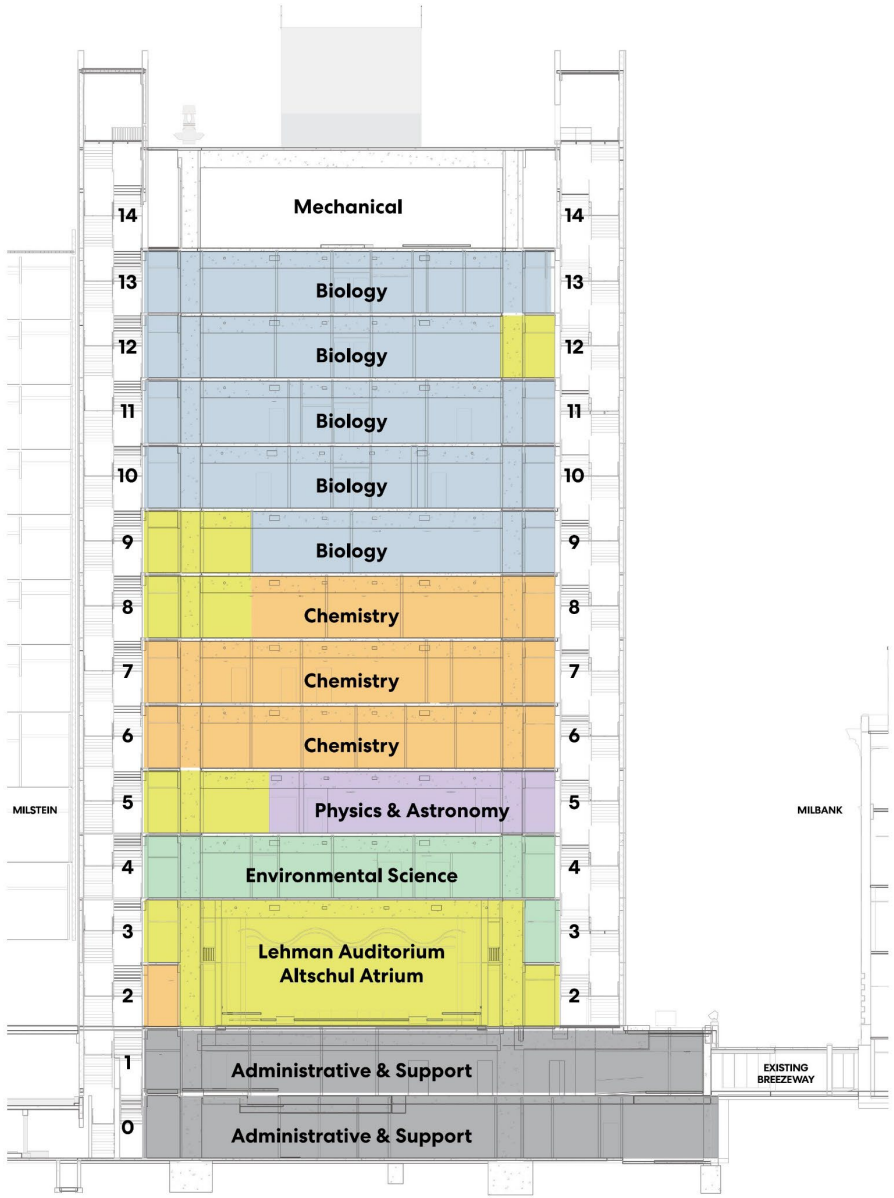
AUDITORIUM PRE FUNCTION WOOD FLOORING (TO BE REUSED AT SECOND FLOOR GALLERY)

GRANITE STAIR TREADS (TO BE REUSED AS WINDOW SILLS AT SELECT LOCATIONS)

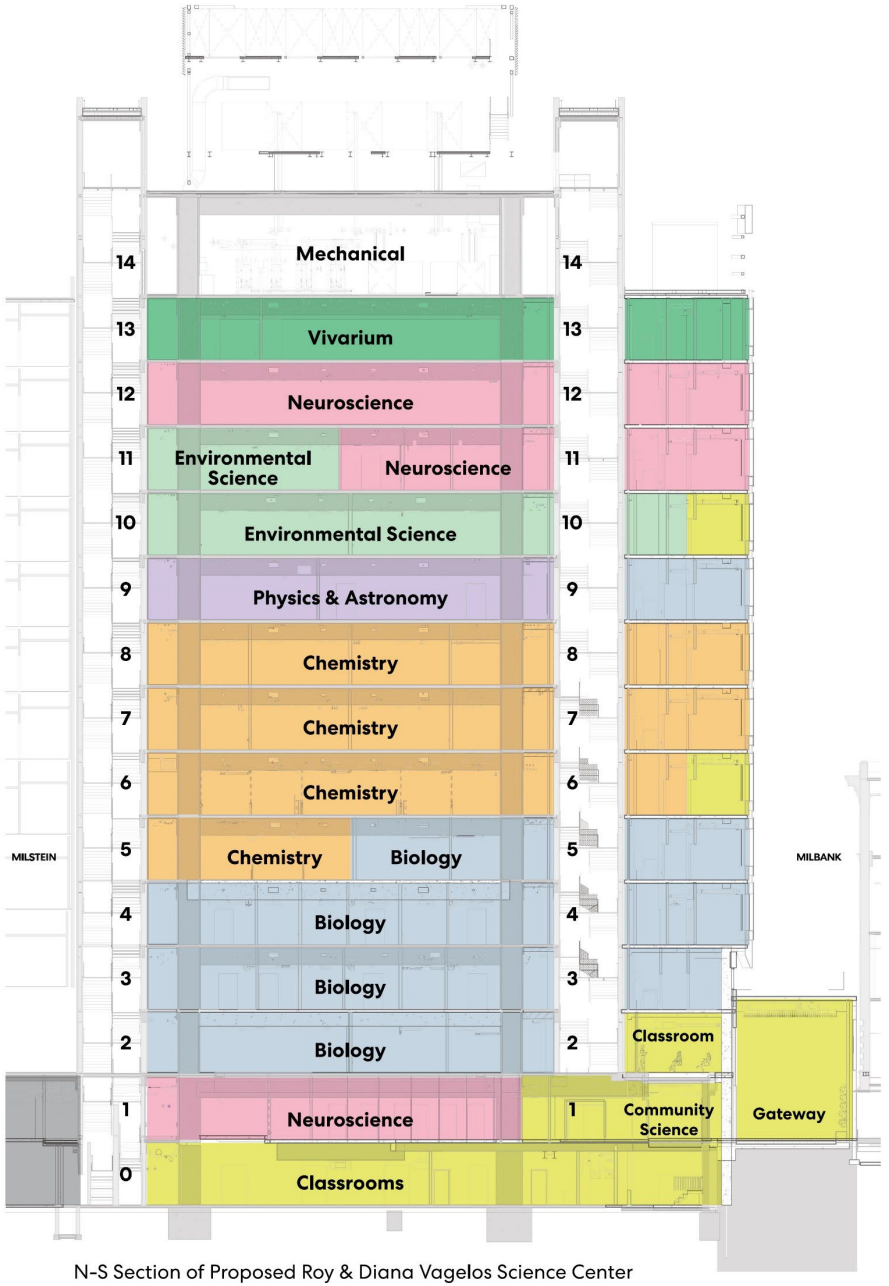
ALTSCHUL LIMESTONE

BLACKBOARDS (AS APPLICABLE, PENDING FURTHER DISCUSSIONS WITH FACULTY)

atelier ten



N-S Section of Existing Altschul Hall



N-S Section of Proposed Roy & Diana Vagelos Science Center

Approach

Can we measure the carbon impact of project programming decisions?

Extracting Project Data - EPD Data

Other Sources of Data

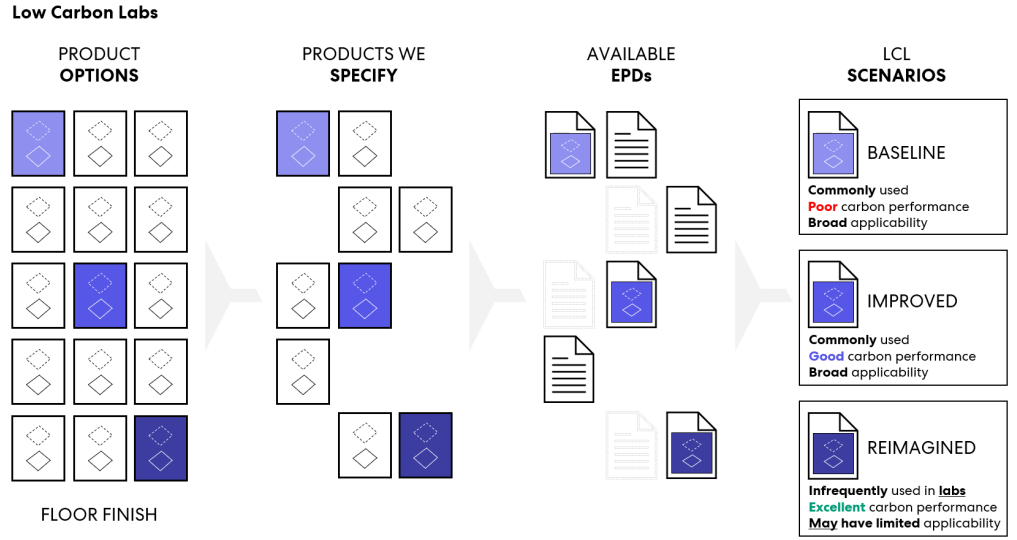
As noted in the Innovation Incubator Low Carbon Labs, not all materials utilized within laboratory design, despite having EPDs, are available within existing tools like Tally and EC3.

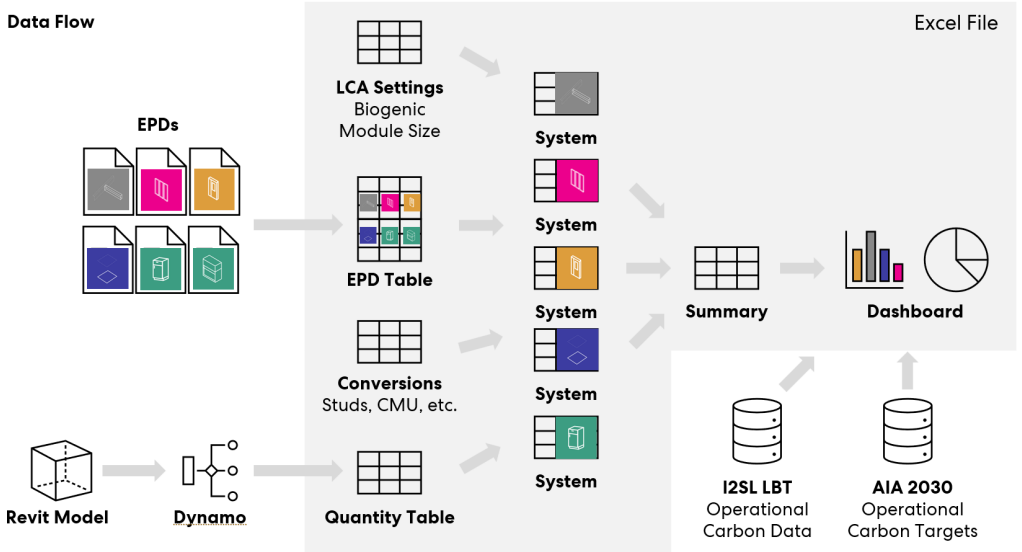
To be able to select the various products utilized within laboratory design to be used in this analysis, we took the EPD table from Low Carbon Labs as they example database to select materials from. We envision that in future efforts this database could be pre -set, or teams could work within existing industry standard databases, such as EC3 or Carbon Leadership Forum's Material Baseline, as they are developed to include more materials.

These datasets would then be utilized to inform design scenarios. Given the current limitations of AreaSync noted previously, this study focused on applying materials to areas, limiting us to floors, and ceilings. Our aspirations looking ahead would see AreaSync allow us to grab data from more families and expand this analysis.

Our analysis focused on A1-A3, as it was where we could gather the most consistent data, contributes to the bulk of carbon impacts, as well as the stages we can control through specification and procurement.

Low Carbon Labs						Product Data				GWP Values (kg/CO2e)	
Spec Section	LCA Category	LCA Subcategory	Display Name	Product Name	Product Description	Environmental Product Declaration (EPD)	Product Literature	Reference Link	0	A1-A3	Biogenic Carbon
09 58 13	INTERIOR	CEILING	DRYWALL CEILING SYSTEM	Acoustical Dry Wall Ceiling	Ensemble Acoustical Drywall Ceiling USG Corporation	https://www.usg.com/content/dam/USG_Marketing_Communications/united_states/product_promotional_materials/f					
09 51 00	INTERIOR	CEILING	ACOUSTICAL CEILING SYSTEM	Armstrong Calla Ceiling Panels		https://www.armstrongceilings.com/content/dam/armstrongceilings/commercial/north_america/ends/calla_end.pdf					
09 51 00	INTERIOR	CEILING	ACOUSTICAL CEILING CLEANROOM	Armstrong Clean Room FL Ceiling Panels	Mineral Fiber Prelude XL, Prelude Plus XL, Prelude XL Fine Fissured, Cleanz Room	https://www.armstrongceilings.com/content/dam/armstrongceilings/commercial/north_america/ends/clean_room_fl					0.00E+00
09 51 00	INTERIOR	CEILING	ACOUSTICAL CEILING	Armstrong Optima Ceiling Panels	HIGH PERFORMANCE FIBERGLASS Prelude XL, Suprafine XL, Silhouette XL	https://www.armstrongceilings.com/content/dam/armstrongceilings/commercial/north_america/ends/ceilings_optima_end.pdf					
09 51 00	INTERIOR	CEILING	ACOUSTICAL CEILING SYSTEM	Armstrong Ultima Ceiling Panels		https://www.armstrongceilings.com/content/dam/armstrongceilings/commercial/north_america/ends/ceilings_ultima_end.pdf	https://www.armstrongceilings.com/commercial/en/commercial-ceilings-walls/ultima-high-performance-ceilings-tiles.html	https://www.armstrongceilings.com/commercial/en/performance/sustainable-building-design/environmental-product-			
09 51 00	INTERIOR	CEILING	ACOUSTICAL CEILING SYSTEM	Armstrong Ultima Health Zone						3.52E+00	
09 22 26	INTERIOR	CEILING	DRYWALL FINISH	Drywall Grid System		https://www.armstrongceilings.com/pdbupimages-dp/7167785.pdf?download&end-downlo	https://www.armstrongceilings.com/pdbupimages-dp/259191.pdf?download&data-sheet-0	https://www.armstrongceilings.com/commercial/en/performance/sustainable-building-design/environmental-product-			
09 53 00	INTERIOR	CEILING	DRYWALL CEILING SYSTEM	Grid Suspension System	Ceiling Grid Suspension System	https://www.armstrongceilings.com/content/dam/armstrongceilings/commercial/north_america/ends/suspension_s		https://www.armstrongceilings.com/commercial/en/performance/sustainable-building-design/environmental-product-			
09 83 16	INTERIOR	CEILING	ACOUSTIC FINISH	International Cellulose K-13	K-13 is a total system of recycled natural fibers, chemical treatment, binding	https://www.transparencycatalog.com/assets/uploads/pdf/ICC_K-13_EPD_May21.pdf				1.37	
10 51 00	INTERIOR	CEILING	ACOUSTICAL CEILING	TecTum Ceiling+Wall Panels	Armstrong® Tectum® Ceiling and Wall Panels are	https://www.armstrongceilings.com/content/dam/armstrongceilings/commercial/north_america/ends/tectum-end.pdf					
09 58 13	INTERIOR	CEILING	DRYWALL CEILING SYSTEM	USG Ensemble	Acoustical drywall ceiling USG, including backup framing	https://www.usg.com/content/dam/USG_Marketing_Communications/united_states/product_promotional_materials/f	https://www.usg.com/content/usgcom/en/products/ceilings/integrated-ceiling-systems/ensemble-acoustical-drywall-			1420.00	
09 65 00	INTERIOR	FLOOR FINISH	RESILIENT FLOORING (PVC FREE)	Armstrong Medinpure		https://www.armstrongflooring.com/pdbupimages-fr/222612.pdf		https://www.armstrongflooring.com/commercial/en-us/resources/resource-results.html?contentTypes=documents&p		15.60	
09 60 00	INTERIOR	FLOOR FINISH	CARPET BROADLOOM	AtlasMasland Broadloom Carpet Family		https://info.nsf.org/Certified/Sustain/ProdCert/EPD10348.pdf				15.60	
09 67 23	INTERIOR	FLOOR FINISH	EPOXY FLOORING	Dur-A-Flex Epoxy Flooring		https://www.dur-a-flex.com/wp-content/uploads/2020/02/dur-a-flex_end_epoxy_floor	https://www.dur-a-flex.com/architect-center/product-data-sheets/	https://www.dur-a-flex.com/architect-center/		15.60	0.00E+00
09 65 00	INTERIOR	FLOOR FINISH	LINOLEUM FLOORING	Forbo Marmoleum		https://forbo.blob.core.windows.net/forbodocuments/13127/Forbo_Marmoleum_Modified_2.0&2.5mm_EPD.pdf	https://forbo.blob.core.windows.net/forbodocuments/275471/ProductGuide_12_2020_Web.pdf	https://forbo.blob.core.windows.net/forbodocuments/13127/Forbo_Marmoleum_Modified_2.0&2.5mm_EPD.pdf		15.60	0.00E+00
09 60 00	INTERIOR	FLOOR FINISH	CARPET TILE	INTERFACE CQUEST BIOX		https://interfaceinc.scene7.com/is/content/InterfaceInc/Interface/Americas/WebsiteContentAssets/Documents/Techni				15.60	-1.35E+01
09 60 00	INTERIOR	FLOOR FINISH	CARPET TILE	INTERFACE GLASBAC TYPE 66 NYLON		https://interfaceinc.scene7.com/is/content/InterfaceInc/Interface/Americas/WebsiteContentAssets/Documents/Techni				15.60	
09 65 00	INTERIOR	FLOOR FINISH	RESILIENT SHEET	Matter Surfaces Fusion Purline						2.76E+00	-1.70E+00
09 65 00	INTERIOR	FLOOR FINISH	RESILIENT TILE	Matter Surfaces Purline						2.76E+00	-1.70E+00

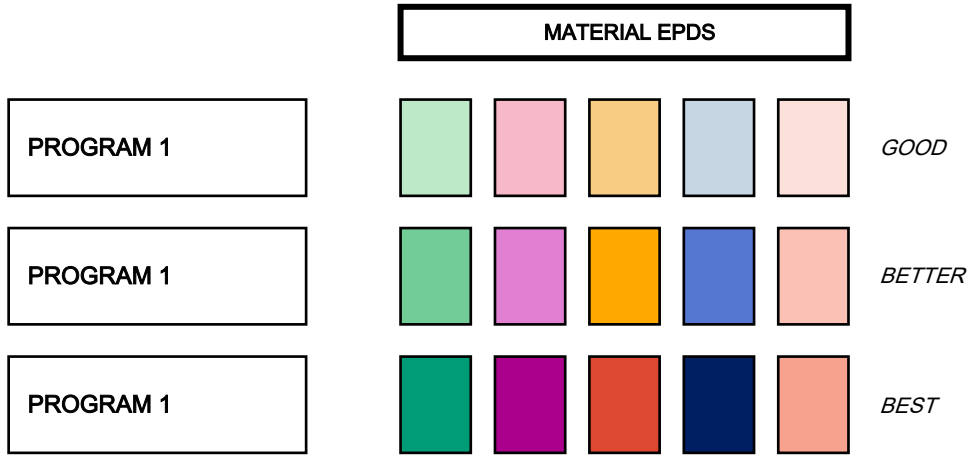




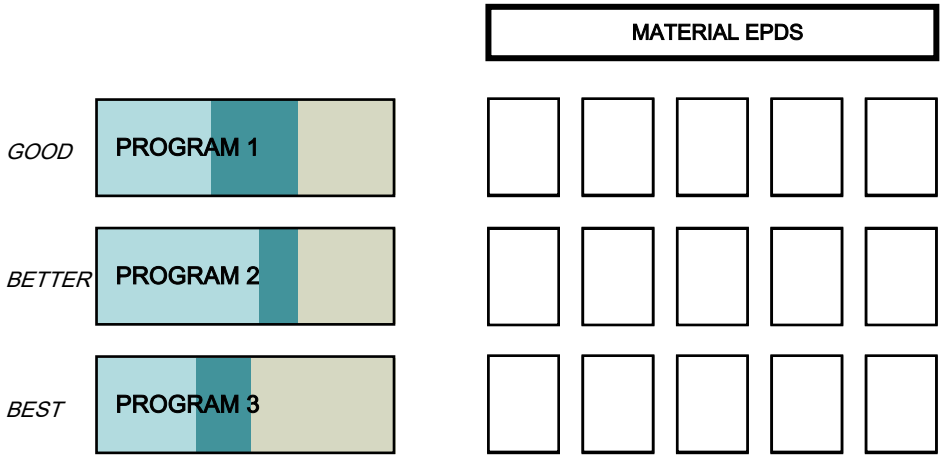
Mapping the Questions – How are we developing the Scenarios?

At this point of the project, we asked ourselves how a team might be able to utilize this tool in early phases, ideally influencing design.

Is there a different way to approach programming when you have this data?



Approach A sets the program as a constant and proposes different materials to achieve carbon reduction goals.



Approach B sets the material as constant and proposes variations in program to achieve carbon reduction goals.

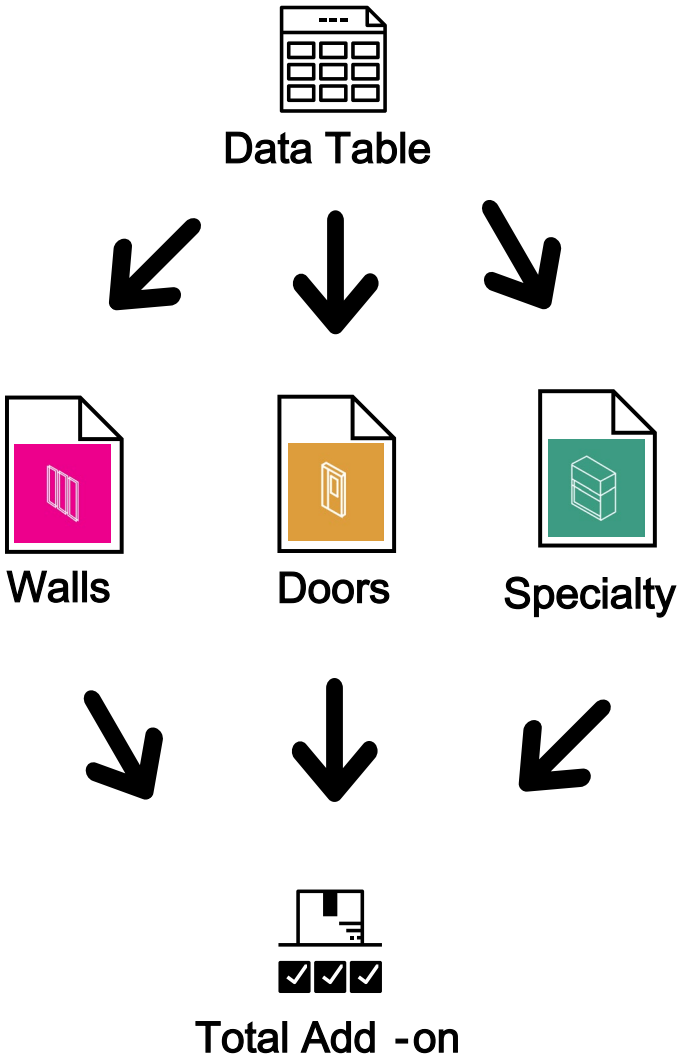
Other Data Parameters

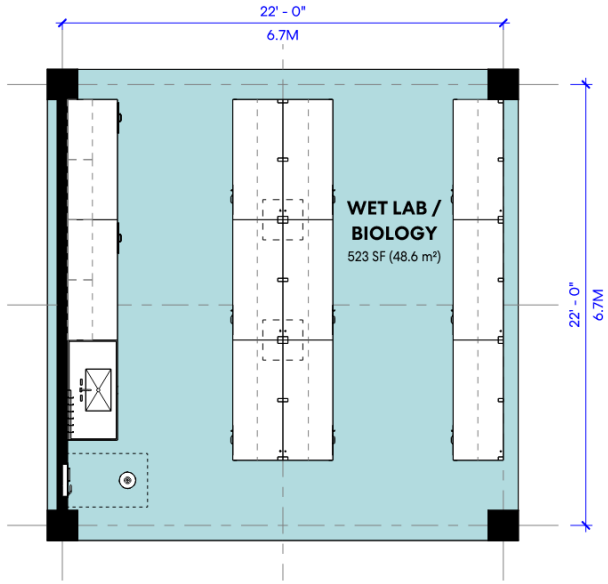
Even though we could only extract floors and ceilings at this time, following this workflow approach would allow us to have more accurate data and show the need for further Area Sync development.

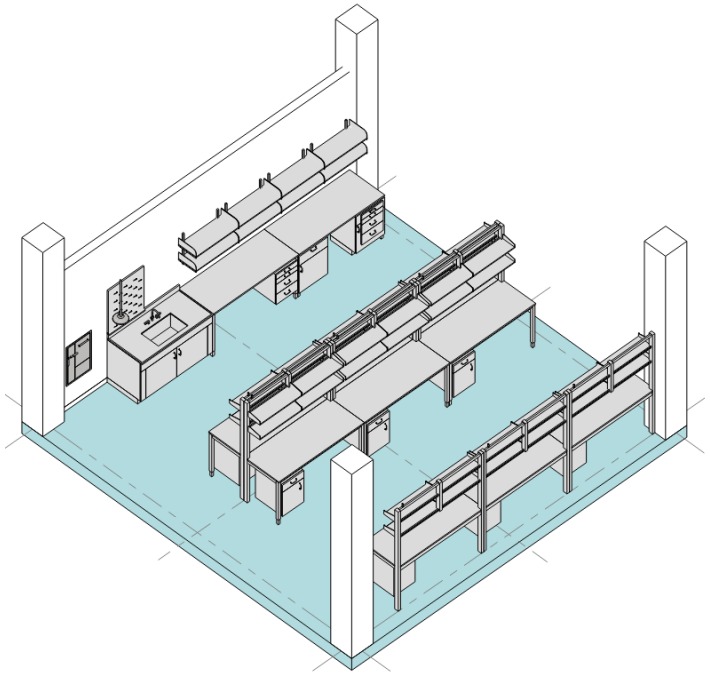
Using a module approach, we were able to define the other elements within these space types to capture a more holistic picture of each room.

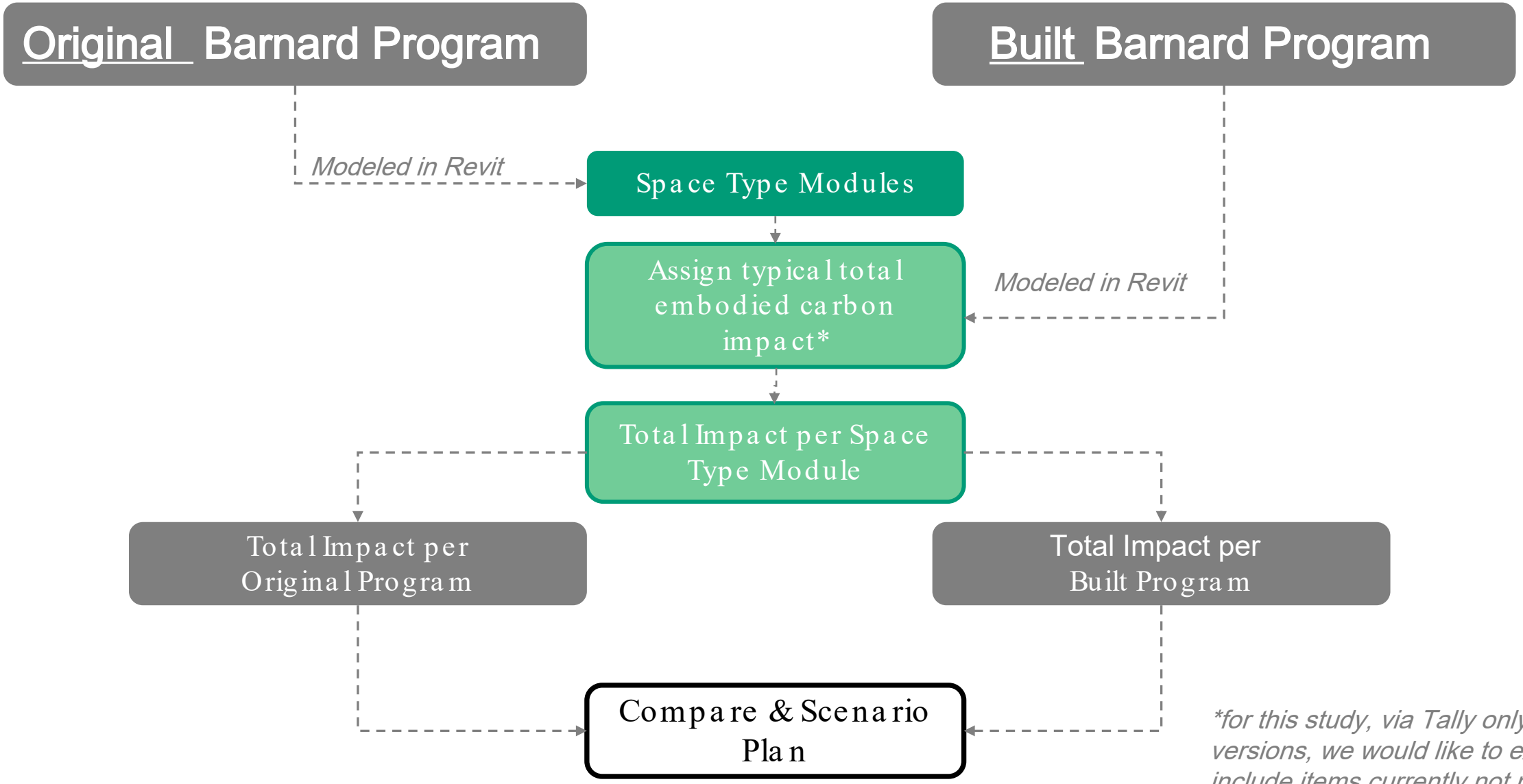
We took each of the space categories, created a module that is in line with real world design, 11' module for lab planning etc. – and then using other data collected via Low Carbon Labs – doors, walls, specialty eq like fumehoods, average material takeoff quantities, we were able to refine that data to a square meter impact value.

This became an additional data set, or add-on number. We use this common denominator multiplied by the area allowing materials to be proportional.









*for this study, via Tally only. In future versions, we would like to expand this to include items currently not measured in Tally, like lab casework.

Compare & Scenario Plan

Questions:

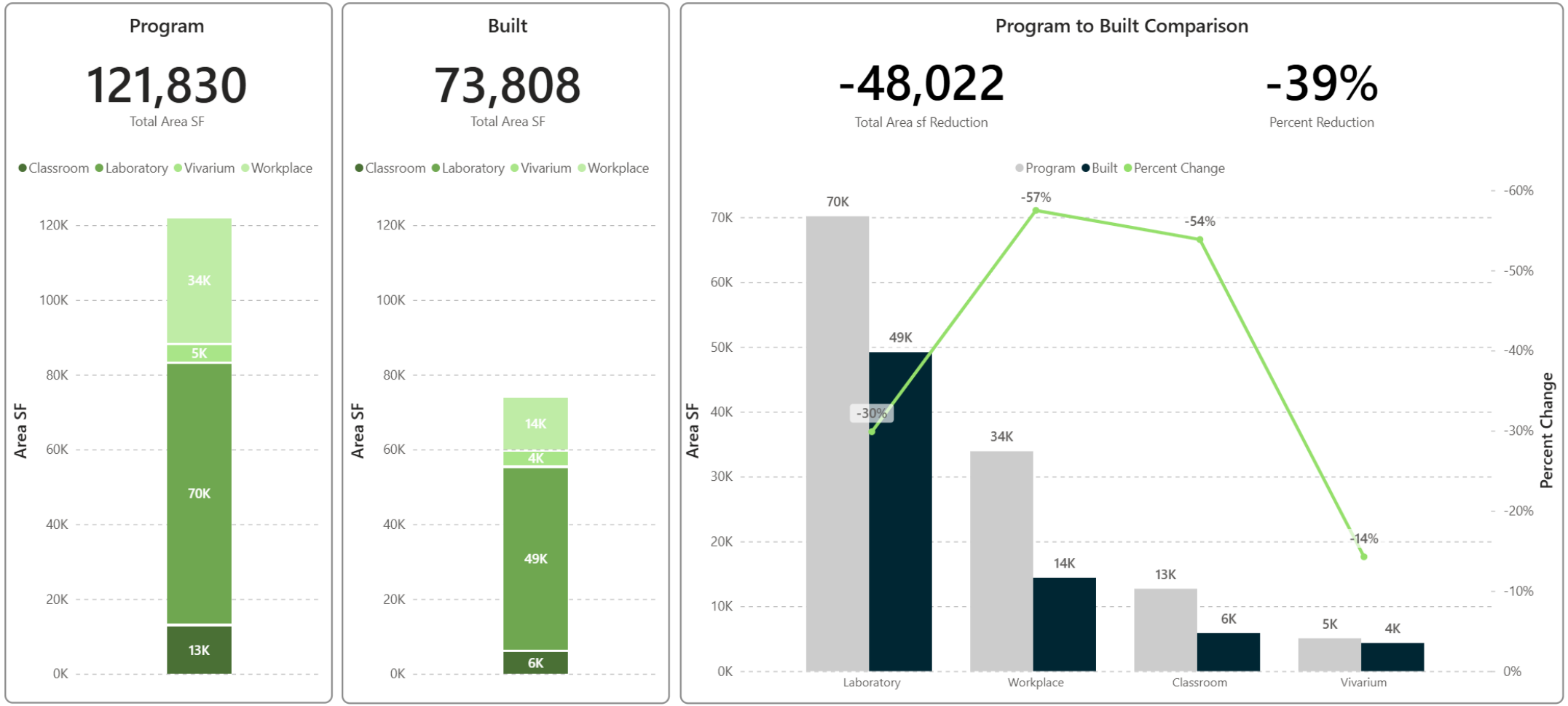
- How does the Original Banard Program compare to the Built Barnard Program, relative to embodied carbon impact?

- Does shifting the size of any specific program have a significant impact on the overall embodied carbon of the project?
  - Example: Vivarium

- Does shifting a singular material have a significant impact on the overall embodied carbon of the project?
  - Example: Flooring, Office/Classroom & Laboratory

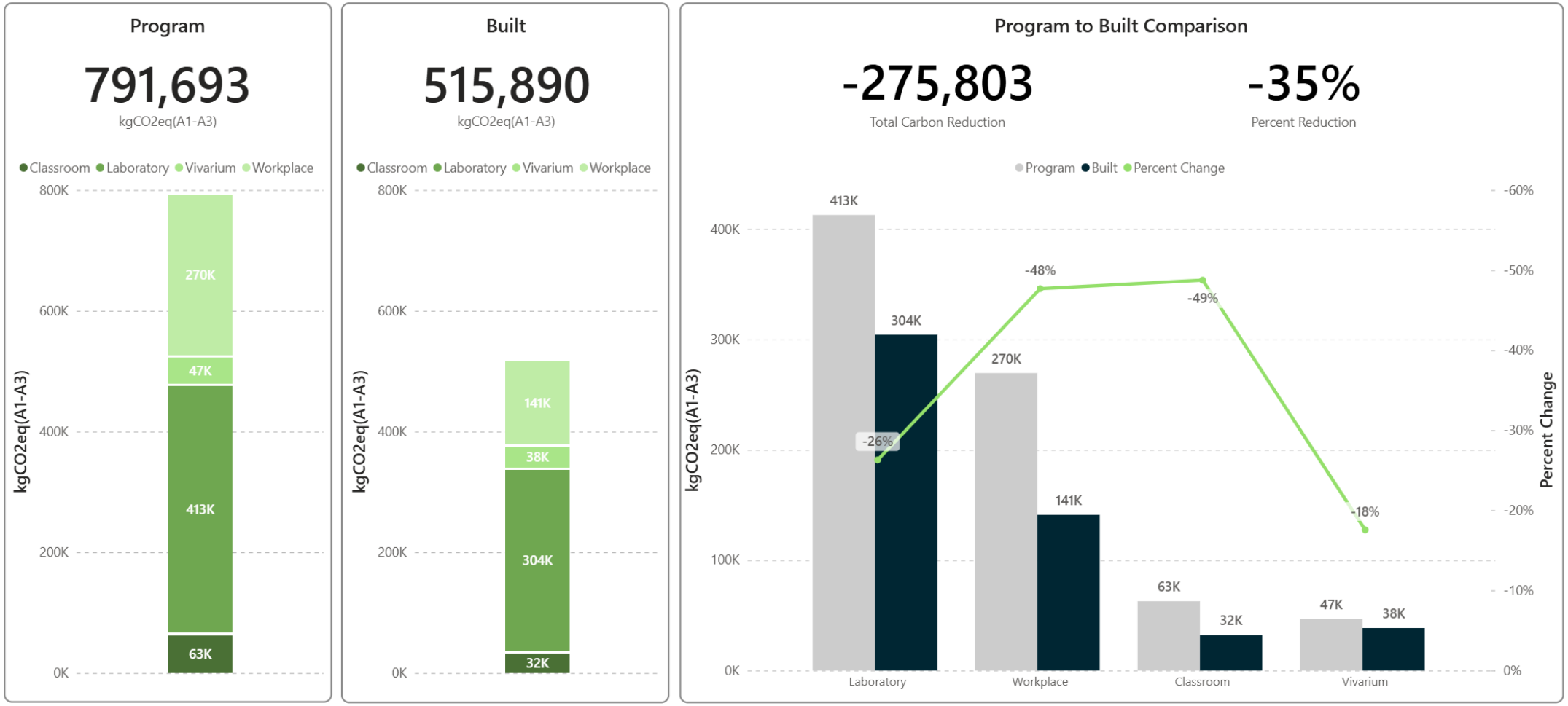
- How can teams set themselves up to be able to deliver this type of analysis in Programming?

How does the Original Barnard Program compare to the Built Barnard Program?



**Both Program and Built excludes Building Support & Circulation spaces (+/ - 60,600 sf)*

How does the Original Barnard Program compare to the Built Barnard Program, relative to embodied carbon impact?



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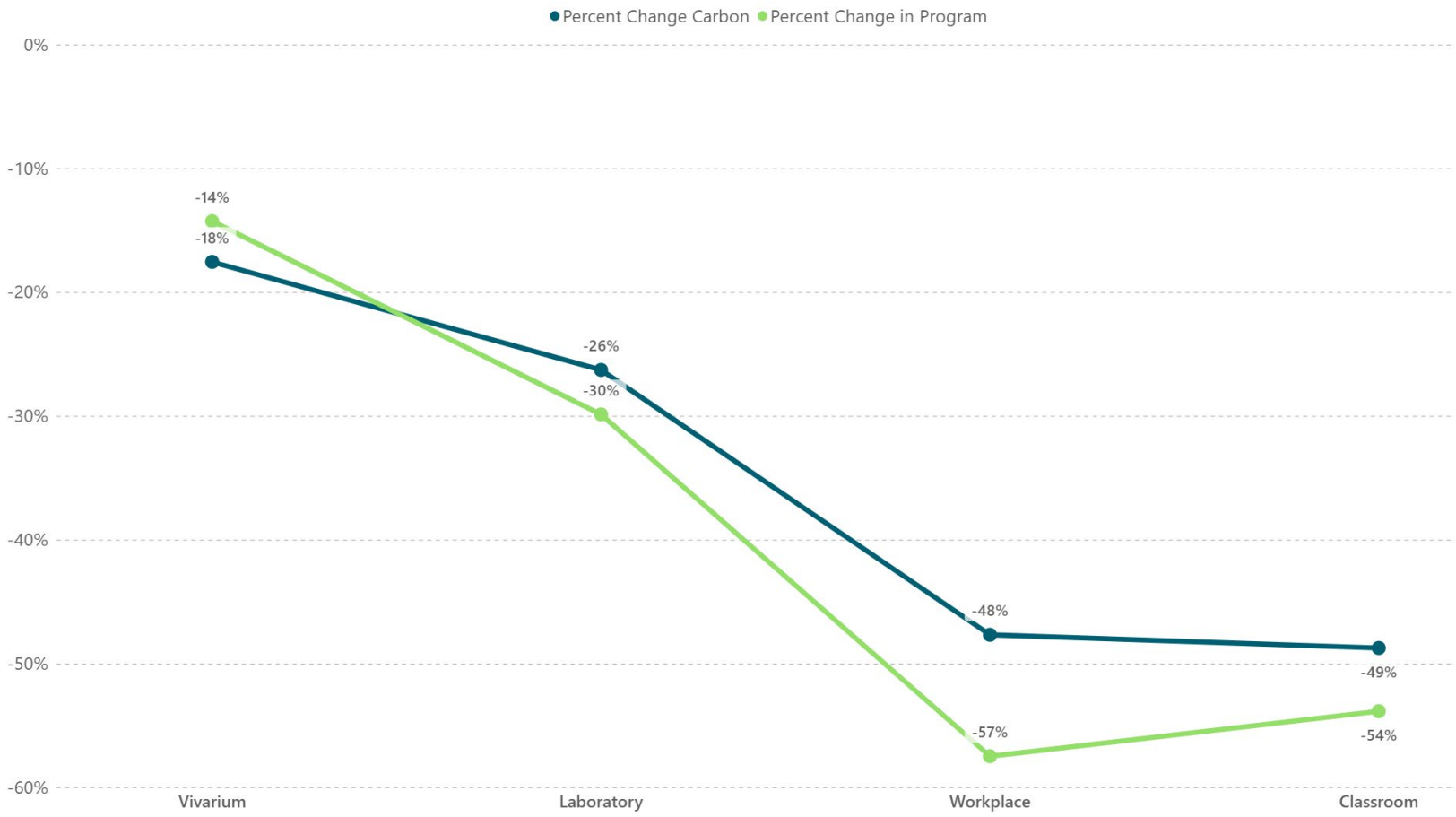
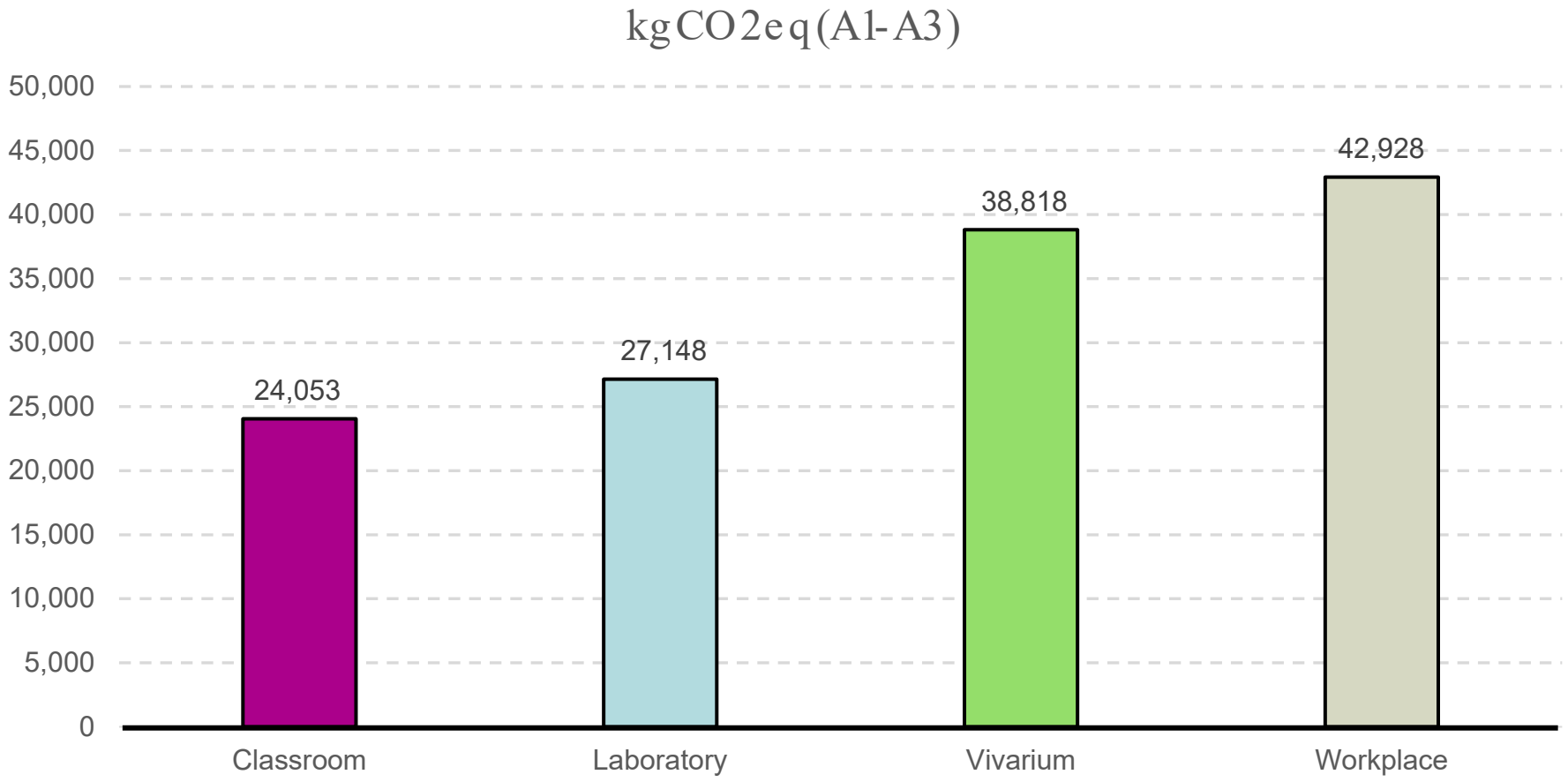


*Both Program and Built excludes Building Support & Circulation spaces (+/ - 60,600 sf)

Does shifting the size of any specific program have a significant impact on the overall embodied carbon of the project?

Vivarium = 4,338 sf



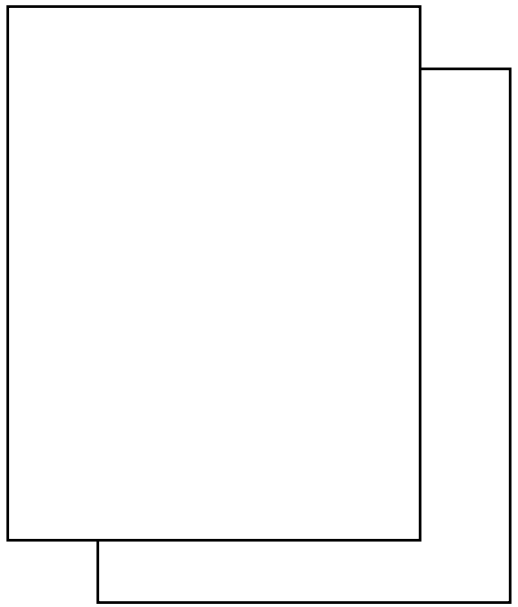
Does shifting a singular material have a significant impact on the overall embodied carbon of the project?

- Example: Lab Flooring

Lab Flooring

48,191 SF* Total in Project

**Excludes Vivarium & Circulation*



Epoxy

9.3 kg CO2e/m ²

Marmoleum

0 kg CO2e/m ²

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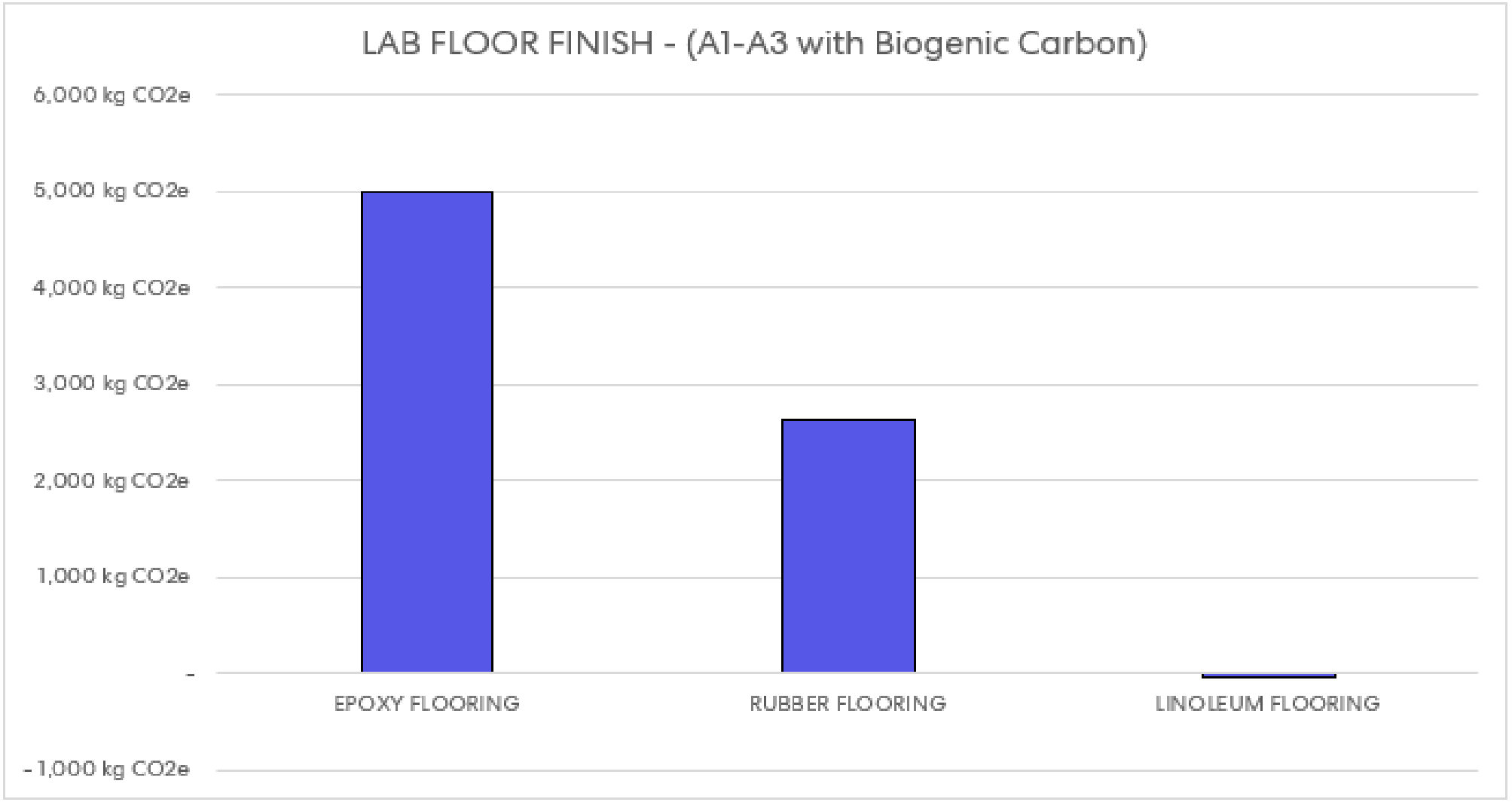
Lab Flooring

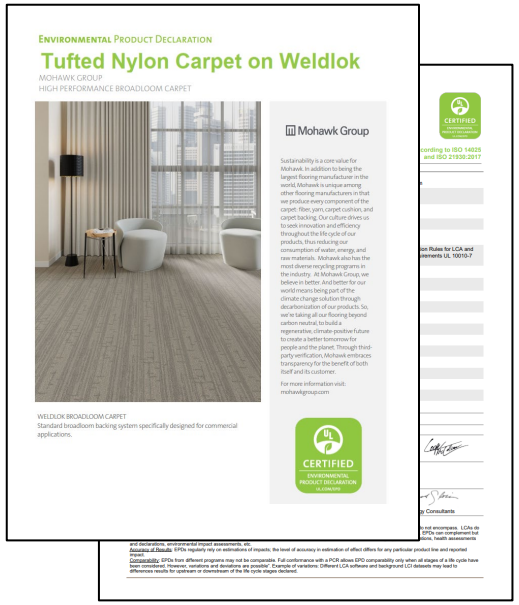


Does shifting a singular material have a significant impact on the overall embodied carbon of the project?

- Example: Office & Classroom Flooring

Office & Classroom Flooring

20,279 SF Total in Project



Broadloom Cpt

52.9 kg CO2e/m ^{2}

Tile Cpt

10.5 kg CO2e/m ^{2}

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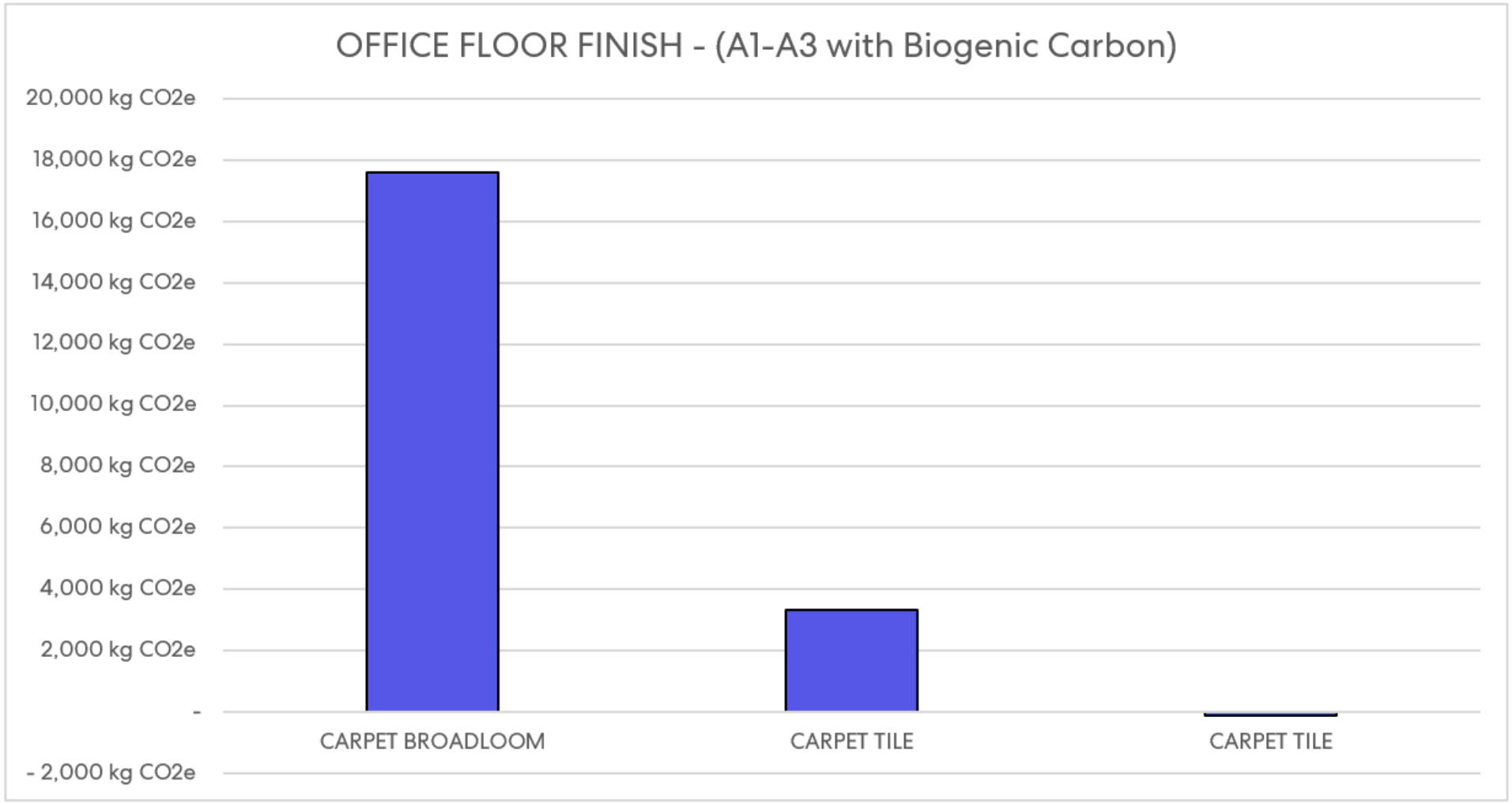
Office Flooring



How can teams set themselves up to be able to deliver this type of analysis in Programming?

Better Modeling Practices	The quality of the data out reflects the quality of the data in. Models, even in Programming, need to be built with intention if they are to be used for analysis.
The sooner, the better!	It is never too early to start looking at your project's embodied carbon impact – even in Programming!
Make a plan, & simplify	A lot of the hurdles the team faced were due to us conducting this analysis in retrospect. Mapping out a plan prior to programming would have eased a lot of the growing pains.

Thank you!