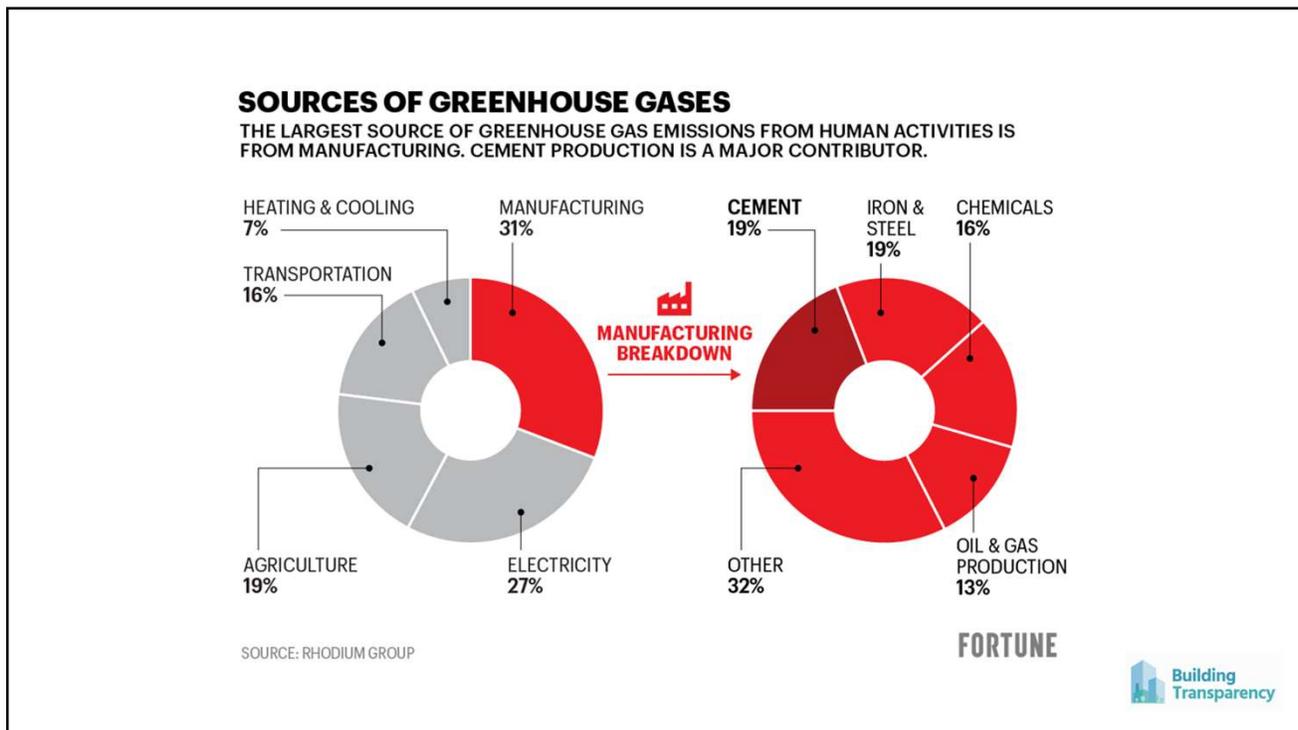
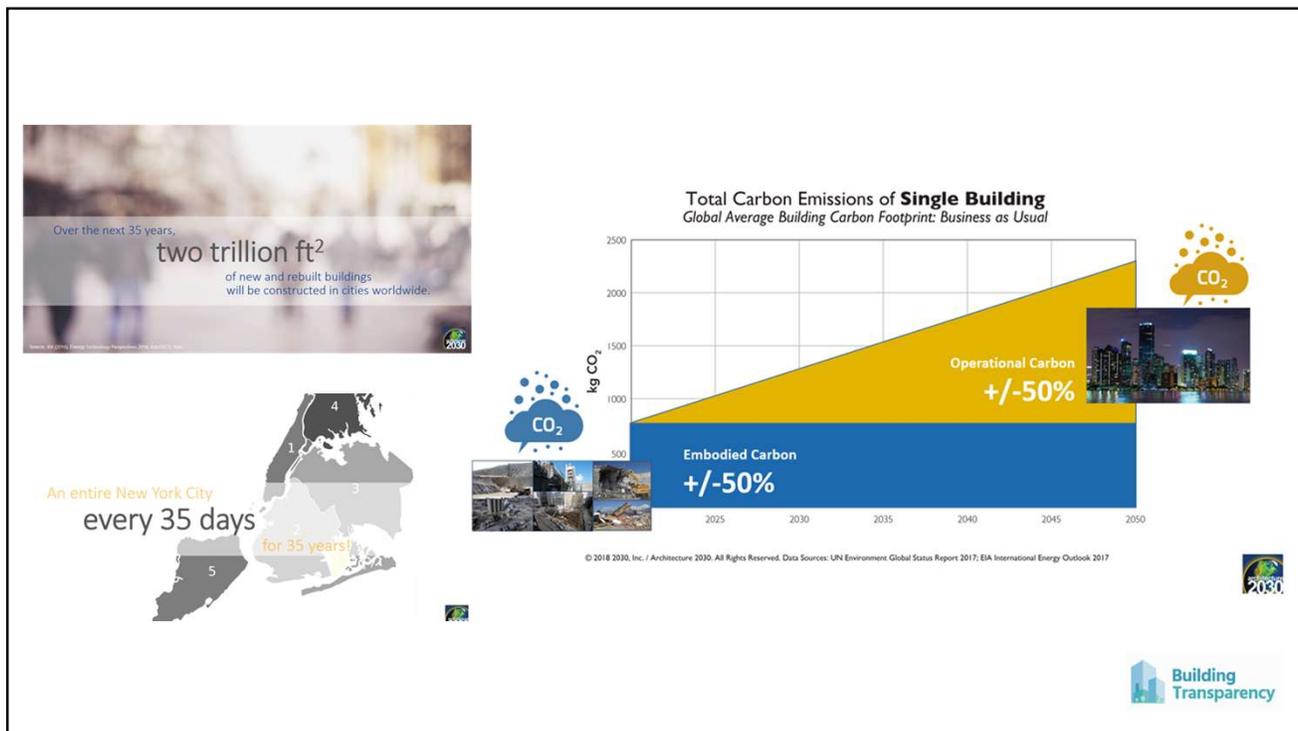




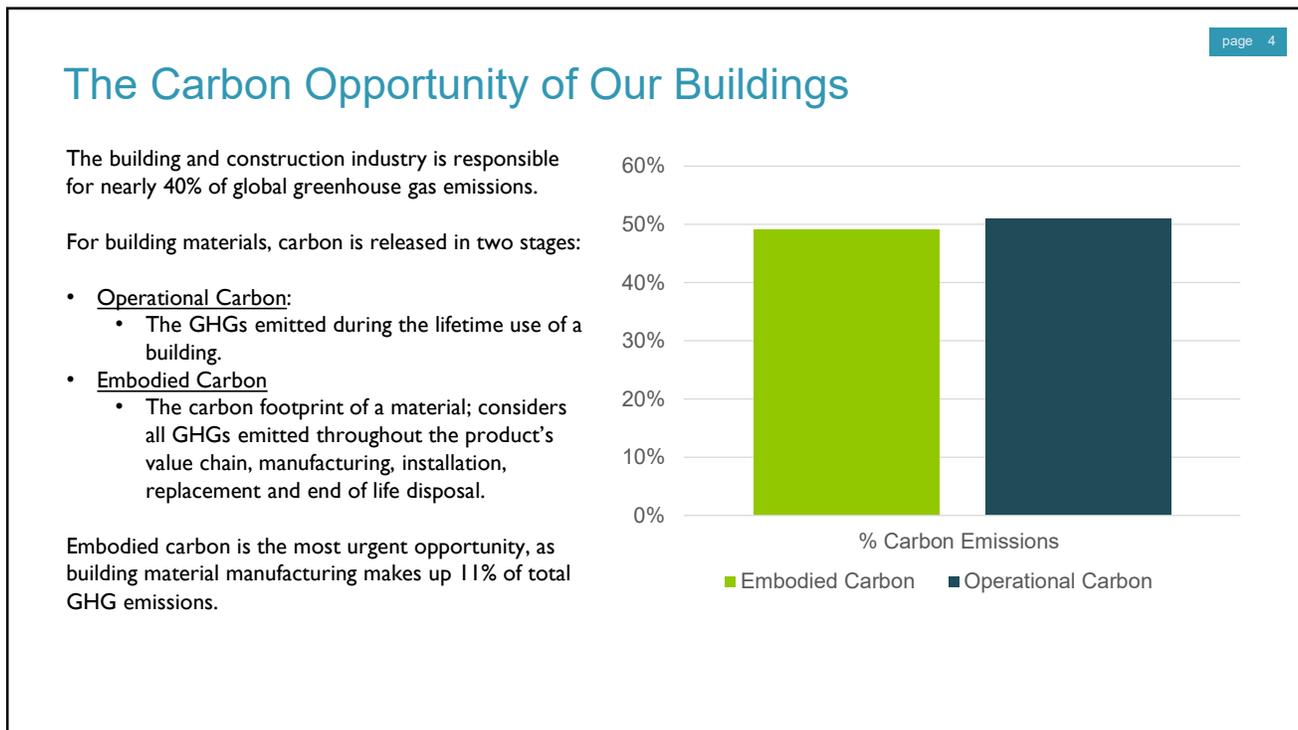
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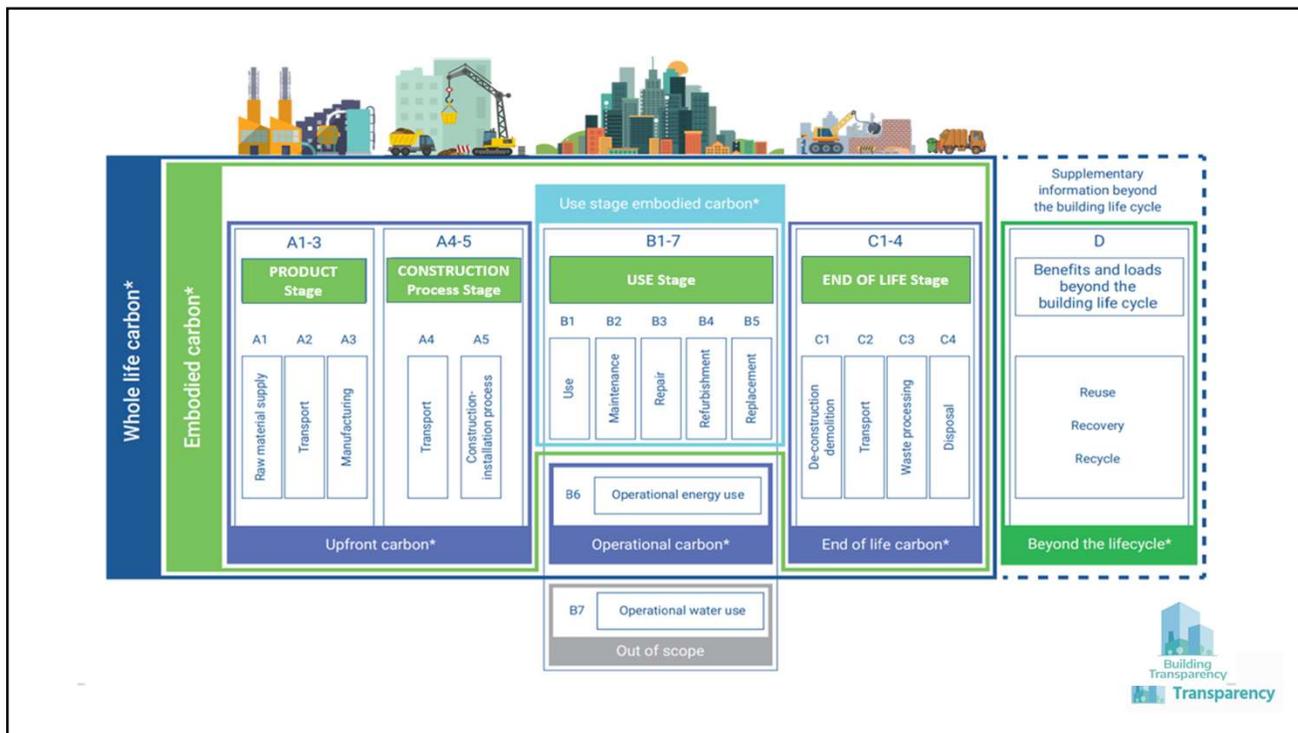
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3



4



5

What is the EPD?

Type III label, third party verified, and internationally recognized

A single transparent disclosure of a product's impacts throughout its life cycle.

EPDs are an evaluation tool to help manufacturers, purchasers, suppliers and distributors from government to institutional facilities evaluate a product's characteristics. Further, they enhance awareness of the overall impact of a product.

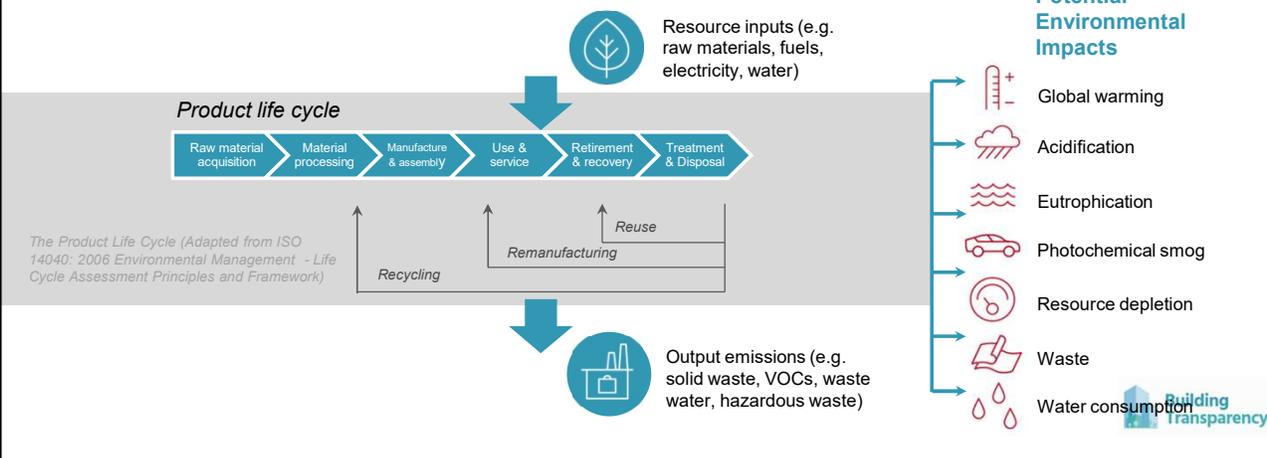
EPDs can represent one product, a group of similar products from one or more manufacturer's site, or multiple manufacturers (e.g. an industry average EPD)

6

EPDs are based on the underlying science of LCA

Life Cycle Assessment provides a way for us to understand the impacts of a product across its value chain. The LCA is the structure for identifying and assessing the many environmental impacts products have and is the core of the EPD.

LCA seeks to establish a link between a system and potential impacts. The LCA provides a systematic procedure for classifying and characterizing these types of environmental effects.



7

What's in an EPD?

An EPD contains:

- General declaration information
- The product definition and information about building physics
- Declared or functional unit of assessment (e.g. m2 of installed product, 1 ton, 100,000 hand drying instances)
- Information about basic materials and the materials' origins
- A description of the product's manufacturing and processing
- Information about installation, in-use conditions and end of life
- LCA results by impact category by life cycle stage, and
- Testing results and verifications.



8

EPD: General Declaration Information

EPD PROGRAM AND PROGRAM OPERATOR NAME, ADDRESS, LOGO, AND WEBSITE	UL Environment 333 Pfingsten Road Northbrook, IL 60061 https://www.ul.com/ https://spot.ul.com
GENERAL PROGRAM INSTRUCTIONS AND VERSION NUMBER	General Program Instructions v.2.4 July 2018
MANUFACTURER NAME AND ADDRESS	Resilient Floor Covering Institute 115 Broad St, Suite 201, La Grange, GA 30240
DECLARATION NUMBER	4788753451.101.1
DECLARED PRODUCT & FUNCTIONAL UNIT OR DECLARED UNIT	Heterogeneous Vinyl Flooring, 1 m ²
REFERENCE PCR AND VERSION NUMBER	Part B: Flooring EPD requirements [UL Environment], v.2.0 September 2018
DESCRIPTION OF PRODUCT APPLICATION/USE	Commercial and residential flooring
PRODUCT RSL DESCRIPTION (IF APPL.)	30 years
MARKETS OF APPLICABILITY	North America
DATE OF ISSUE	January 1, 2019
PERIOD OF VALIDITY	5 Years
EPD TYPE	Industry-average
RANGE OF DATASET VARIABILITY	Industry-average only
EPD SCOPE	Cradle-to-grave
YEAR(S) OF REPORTED PRIMARY DATA	2016-2017
LCA SOFTWARE & VERSION NUMBER	GoBi ts, 8.7
LCI DATABASE(S) & VERSION NUMBER	GoBi 2018 (service pack 36)
LCIA METHODOLOGY & VERSION NUMBER	TRACI 2.1

The PCR review was conducted by:

UL Environment
PCR Peer Review Panel
Chair: Jack Gebig (Ecoform)
<i>Edward R. Martin</i>
Grant R. Martin, UL Environment
<i>Thomas P. Gloria</i>
Thomas P. Gloria, Industrial Ecology Consultants

This declaration was independently verified in accordance with ISO 14025: 2006.
 INTERNAL EXTERNAL

This life cycle assessment was independently verified in accordance with ISO 14044 and the reference PCR by:

Thomas P. Gloria
 Thomas P. Gloria, Industrial Ecology Consultants

LIMITATIONS
Exclusions: EPDs do not indicate if any environmental or social performance benchmarks are met, and there may be impacts that they do not encompass. LCAs do not typically address the site-specific environmental impacts of raw material extraction, nor are they meant to assess human health toxicity. EPDs can complement but cannot replace tools and certifications that are designed to address these impacts and/or set performance thresholds – e.g. Type 1 certifications, health assessments and declarations, environmental impact assessments, etc.
Accuracy of Results: EPDs regularly rely on estimations of impacts; the level of accuracy in estimation of effect differs for any particular product line and reported impact.
Comparability: EPDs from different programs may not be comparable. Full conformance with a PCR allows EPD comparability only when all stages of a life cycle have been considered. However, variations and deviations are possible. Example of variations: Different LCA software and background LCI datasets may lead to differences results for upstream or downstream of the life cycle stages declared.



9

EPD scope

page 10

Defines which product life cycle phases are included in the EPD

- Product Stage (Modules A1-A3): Raw Material and Manufacturing (required)
- Construction Stage (Modules A1-A4): Transportation and Installation
- Use Stage (Modules B1-B7): Use, Maintenance, Repair, and Replacement
- End of Life Stage (Modules C1-C4): Demolition, Waste Processing

PRODUCT STAGE			CONSTRUCTION STAGE		USE STAGE								END OF LIFE STAGE				BENEFITS/LOADS BEYOND SYSTEM BOUNDARY
Raw material supply	Transport	Manufacturing	Transport from gate to site	Assembly/Installation	Use	Maintenance	Repair	Replacement	Refurbishment	Operational energy use	Operational water use	Deconstruction/demolition	Transport	Waste processing	Disposal	Reuse/recovery/recycling-potential	
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	B6	B7	C1	C2	C3	C4	D	
<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>													<input checked="" type="checkbox"/>	<input checked="" type="checkbox"/>	



10

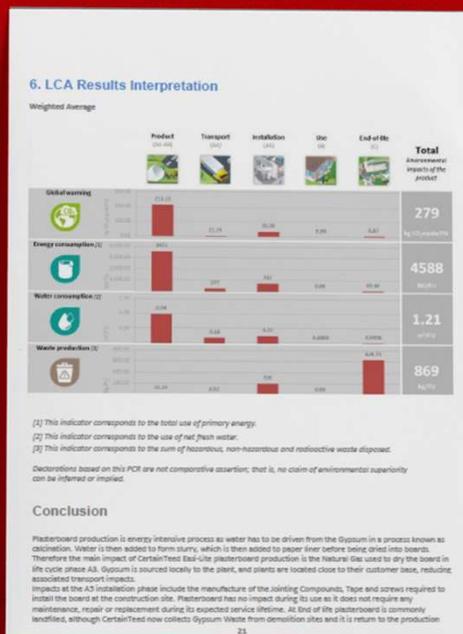
Parameters (Weighted Average)	Units	Production modules	Installation modules		Use modules	End of life modules			
		A1 - A3	A4	A5	B1 - B7	C1	C2	C3	C4
Global Warming Potential (GWP)	kg CO2 eq	2.13E+02	2.12E+01	3.93E+01	0	2.1E+00	3.2E+00	1.6E+00	0
Ozone depletion (ODP)	kg CFC 11 eq	6.47E-06	1.16E-05	3.81E-06	0	2.6E-07	2.2E-06	1.1E-06	0
Acidification potential (AP)	kg SO2 eq	8.13E-01	1.29E-01	1.13E-01	0	1.6E-02	1.9E-02	1.2E-02	0
Eutrophication potential (EP)	kg N - eq	1.68E-01	2.62E-02	3.27E-02	0	3.7E-03	4.8E-03	2.5E-03	2.1E-02
Photochemical ozone creation (POCP) -	kg O3 - eq	7.66E-02	9.30E-03	1.24E-02	0	4.7E-03	1.4E-03	8.9E-04	0
Abiotic depletion potential for fossil resources (ADP-fossil fuels)	MJ	3.00E+02	1.87E+01	6.88E+02	0	2.9E+01	4.0E+01	2.0E+01	0

Results are presented by impact category across each life cycle module.

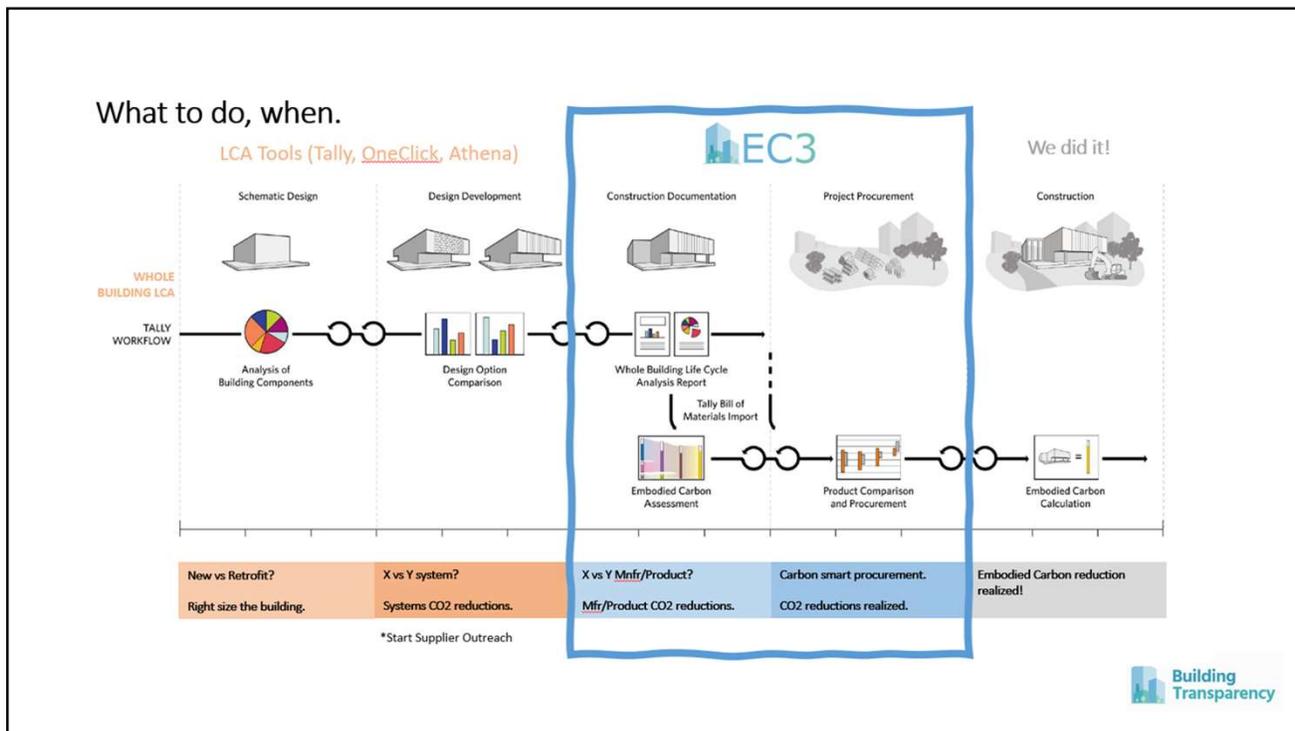


11

The Life Cycle Assessment describes the environmental impacts that result from the manufacturing, transport, installation, use, and disposal of the product. Over 76% of the primary energy is in the production stage of the life cycle with small contributions from the installation, use and end of life stages as seen in the bar graph.



12



13

EC3, the Embodied Carbon Calculator for Construction

page 14

Industry is moving towards using software tools to calculate and track their own carbon footprints, create supply-chain specific product EPDs, and provide this information to tools such as EC3.

EC3 is:

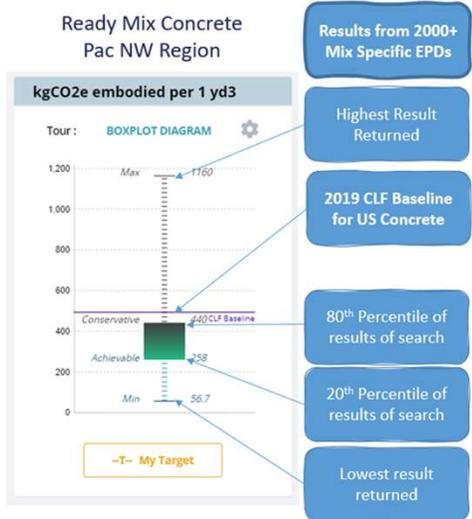
- A climate impact toolkit
- A database of verified EPDs
- A construction industry collaboration
- Provides a way for designers to calculate the embodied carbon impacts of buildings based on specific products and materials

This is increasingly important as legislation such as the Buy Clean California Act, AB 262, will require product EPDs that are facility specific.

Building Transparency

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How EC3 works: Understand range of GWP/unit of material to set baselines and targets.



High, conservative baseline.

Based on EPD database, industry average data, LCA data.

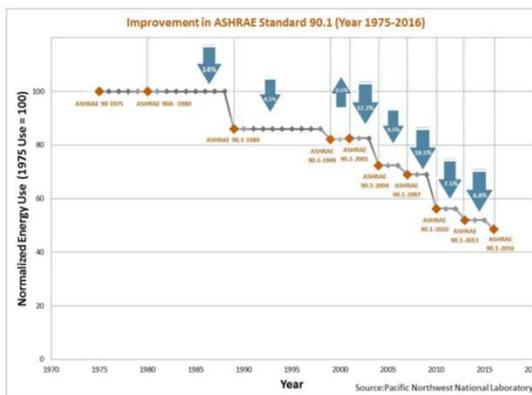
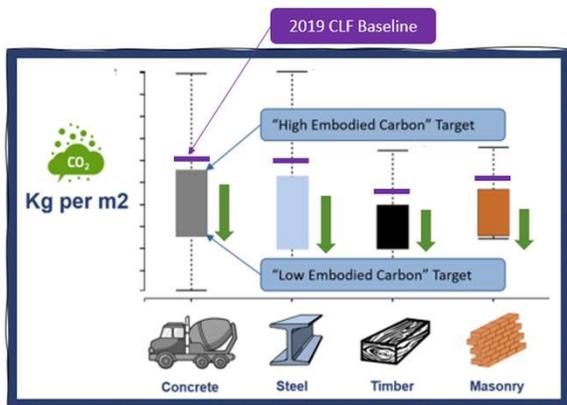
Incentivizes disclosure by not just the lowest carbon products.

Sets a static, published baseline for reduction targets to be set and reductions to be tracked.



17

Baselines and targets can be optimized/lowered over time as more EPD data is available and lower carbon options come to market.



18

How EC3 works: Set your performance and location criteria to apply a collection of EPD data to your material quantities.

SEARCH BY PROPERTIES: 03 30 00 CAST-IN-PLACE CONCRETE

DESIGN INTENT

Compressive Strength: 5000 psi

GEOGRAPHIC

Max Distance from Project Site: 100 miles

INDUSTRY EPDS

PRODUCT EPDS

Samples: 2158 Achievable: 284 kgCO₂e Average: 353 kgCO₂e ± 27.7% Conservative: 420 kgCO₂e Declared Unit: 1 yd³

Subcategory	ReadyMix	Central Concrete	Bode C	Mix PG1CSP1	EF70WC42EF-70...	5000 psi	238 kgCO ₂ e	3.25 miles
ReadyMix	Central Concrete	Bode C	Mix XE5EC5C1	FLATWORK 0.45...	5000 psi	397 kgCO ₂ e	3.25 miles	
ReadyMix	Central Concrete	Bode C	Mix W6GEC3...	EFV2 75k CF 3" LI...	5000 psi	308 kgCO ₂ e	3.25 miles	
ReadyMix	Central Concrete	Bode C	Mix W6G112...	*****CM-66...	4500 psi	323 kgCO ₂ e	3.25 miles	



19



How EC3 works: Once you've entered your quantities and applied your EPD collections, view the range of potential embodied carbon for your project.

CHUCK'S LAIR

GWP SAVINGS OPPORTUNITIES FOR CHUCK'S LAIR (UNIFORM2 VIEW)

Embodied carbon impacts of a material category, for your project's quantities and available supply chain

Embodied carbon reduction potential based on material collection searches and available EPDs

Embodied carbon reduction potential for the project



20

The current steps for low embodied carbon procurement.

If a manufacturer/product doesn't have an EPD, ask for one.

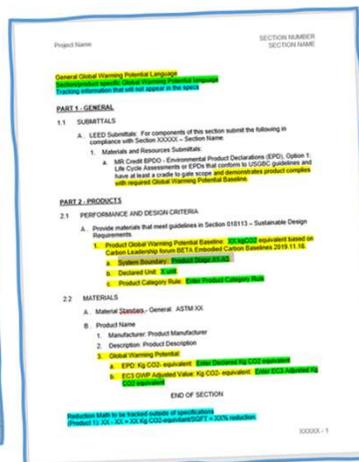
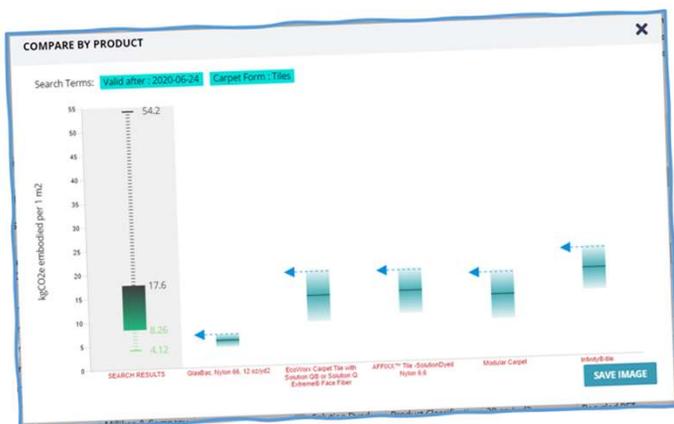
www.buildingtransparency.org



21

The current steps for low embodied carbon procurement.

If manufacturers/products do have EPDs, specify them.



22

The current steps for low embodied carbon procurement.

Be sure the request makes it into Bid Documents!

Member	Bid Form F ¹	Nominal F _c ²	Exposure Class ^{3,4}	Shrinkage Limit (%)	Max Aggregate Size	Modulus	Supplier A	Sup
Spread Footings/Mats		5.0 ksi	F0/W1/C1	0.05 1"			Mix 1 293 kg/m ³	537.3
Basement Walls (Shotcrete)		5.0 ksi	F0/W1/C1	0.05 1"			Mix 2 416 kg/m ³ (6.0 ksi)	502.5
Basement Walls (Cast-in-Place)		5.0 ksi	F0/W1/C1	0.05 1"			Mix 1 293 kg/m ³	377.4
Slab on Grade	4-6 ksi	5.0 ksi	F2/W1/C1	0.04 1"			Mix 1 293 kg/m ³	307.4
Interior Mid Slab, Beams and Columns	6.0 ksi	5.0 ksi	N	0.04 1/4"	4000 ksi		Mix 3 296 kg/m ³	537.3
Interior Post-tensioned Slabs	6.0 ksi/3.0 ksi at stressing	5.0 ksi	N	0.04 1/4"	4400 ksi		Mix 4 371 kg/m ³	441.2
Post-tensioned Slabs exposed to weather	6.0 ksi/3.0 ksi at stressing	5.0 ksi	F3/W1/C2	0.04 1/4"	4400 ksi		Mix 4 371 kg/m ³	400.8
Interior Shear Walls	6.0 ksi	5.0 ksi	N	0.04 1/4"	4400 ksi		Mix 3 296 kg/m ³	441.2
Misc. Curbs/ Sidewalks/Arch. Pads	4-6 ksi	5.0 ksi	F2/W1/C1	0.04 1/4"	5100 ksi		Mix 3 296 kg/m ³	337.3
Interior Slab on Deck	4-6 ksi	5.0 ksi	N	0.04 1/4"			Mix 1 293 kg/m ³	337.3

This project is benchmarking and tracking construction materials Stage A1-A3 upfront embodied carbon emissions as part of its sustainability requirements in order to achieve embodied carbon reductions. Stage A1-A3 upfront embodied carbon emissions are the carbon emissions associated with the extraction and manufacture of construction materials, as reported in third party verified Environmental Product Declarations (EPDs).

As part of each response to this bid, bidder shall provide:

1. A mix specific representative EPD for each proposed concrete mix included in this bid document. Potential concrete mix Global Warming Potential (GWP), otherwise known as kgCO₂e/cy, as provided in EPDs submitted will be included in the assessment of each bid response.
2. If mix specific EPDs are not currently available by the bidder:
 - a. GWP numbers utilizing UW Carbon Leadership Forum high baselines will be assumed for the bidder. (<https://crrm.carbonleadershipforum.info/sites/default/files/CLF-EC-Baselines-Beta-2019.11.19.pdf>)
 - b. Bidder shall answer the following questions as part of their bid response.
 - i. Will you commit to providing mix specific EPDs for this project by the construction start date?
 - ii. If not, why not?
 - iii. If so, will you charge the project for the generation of mix specific EPDs?

If selected, bidder shall:

1. Provide mix specific EPDs as part of construction submittals to confirm GWP of mixes installed. If mix specific EPDs are not available, Project will include GWP high baselines as published by the UW Carbon Leadership Forum.



23

The current steps for low embodied carbon procurement.

Be sure the request makes it into Bid Documents!

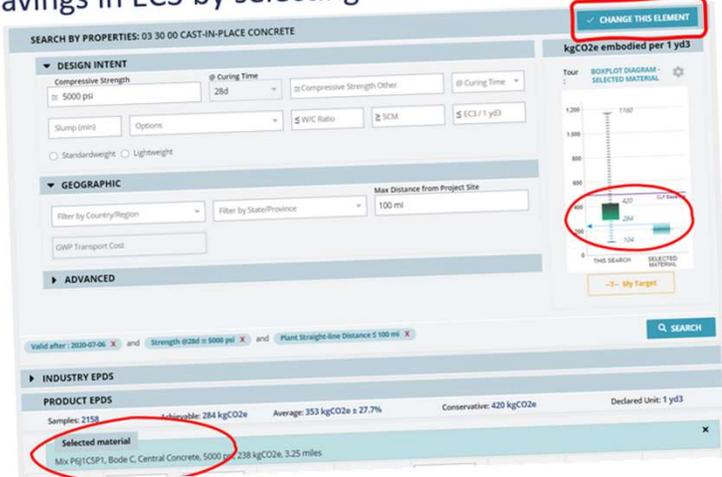
Member	Bid Form F ¹	Nominal F _c ²	Exposure Class ^{3,4}	Shrinkage Limit (%)	Max Aggregate Size	Modulus	Supplier A	Supplier B	2019 CLF Baseline	NRMCA Industry Average (PWW)	Supplier A (compared to average)	Supplier B (compared to average)	Supplier A (compared to baseline)	Supplier B (compared to baseline)
Spread Footings/Mats		5.0 ksi	F0/W1/C1	0.05 1"			Mix 1 293 kg/m ³	Mix 1 537.32 kg/m ³	640 kg/m ³	455.53 kg/m ³	-35.68%	17.95% (above the average)	-54.22%	-16.04%
Basement Walls (Shotcrete)		5.0 ksi	F0/W1/C1	0.05 1"			Mix 2 416 kg/m ³ (6.0 ksi)	Mix 2 502.56 kg/m ³	640 kg/m ³	455.53 kg/m ³	-8.68%	10.37% (above the average)	-35.00%	-21.48%
Basement Walls (Cast-in-Place)		5.0 ksi	F0/W1/C1	0.05 1"			Mix 1 293 kg/m ³	Mix 3 377.41 kg/m ³	640 kg/m ³	455.53 kg/m ³	-35.68%	-17.15%	-54.22%	-41.03%
Slab on Grade	4-6 ksi	5.0 ksi	F2/W1/C1	0.04 1"			Mix 1 293 kg/m ³	Mix 4 307.43 kg/m ³	520 kg/m ³	455.53 kg/m ³	-35.68%	-32.51%	-43.65%	-40.88%
Interior Mid Slab, Beams and Columns	6.0 ksi	5.0 ksi	N	0.04 1/4"	4000 ksi		Mix 3 296 kg/m ³	Mix 1 537.32 kg/m ³	670 kg/m ³	455.53 kg/m ³	-35.02%	17.95% (above the average)	-55.82%	-19.80%
Interior Post-tensioned Slabs	6.0 ksi/3.0 ksi at stressing	5.0 ksi	N	0.04 1/4"	4400 ksi		Mix 4 371 kg/m ³	Mix 5 441.12 kg/m ³	670 kg/m ³	480.03 kg/m ³	-22.71%	-8.11%	-44.63%	-34.16%
Post-tensioned Slabs exposed to weather	6.0 ksi/3.0 ksi at stressing	5.0 ksi	F3/W1/C2	0.04 1/4"	4400 ksi		Mix 4 371 kg/m ³	Mix 6 400.82 kg/m ³	670 kg/m ³	480.03 kg/m ³	-22.71%	16.50%	-44.63%	-40.18%
Interior Shear Walls	6.0 ksi	5.0 ksi	N	0.04 1/4"	4400 ksi		Mix 3 296 kg/m ³	Mix 7 441.12 kg/m ³	670 kg/m ³	455.53 kg/m ³	-35.02%	-3.16%	-53.75%	-31.08%
Misc. Curbs/ Sidewalks/Arch. Pads	4-6 ksi	5.0 ksi	F2/W1/C1	0.04 1/4"	5100 ksi		Mix 5 337.36 kg/m ³	Mix 9 341 kg/m ³	640 kg/m ³	480.03 kg/m ³	-35.42%	-29.72%	-53.73%	-49.65%
Interior Slab on Deck	4-6 ksi	5.0 ksi	N	0.04 1/4"			Mix 6 341 kg/m ³	Mix 10 375.19 kg/m ³	640 kg/m ³	588.03 kg/m ³	-42.01%	-44.06%	-56.84%	-58.36%
							Mix 1 293 kg/m ³	Mix 11 339.59 kg/m ³	640 kg/m ³	455.53 kg/m ³	-35.68%	-17.64%	-54.22%	-41.38%
							Mix 3 296 kg/m ³		640 kg/m ³	455.53 kg/m ³	-35.02%	-25.45%	-53.75%	-46.94%
									Agg Reduction		-31.61% below industry avg	-12.34% below industry avg	-56.37% below 2019 CLF Baseline	-36.75% below 2019 CLF Baseline



24

The current steps for low embodied carbon procurement.

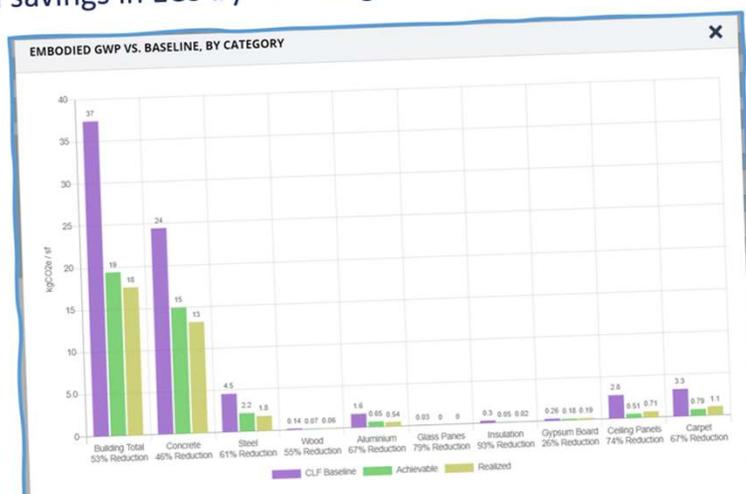
Track realized savings in EC3 by selecting the EPDs for products procured.



25

The current steps for low embodied carbon procurement.

Track realized savings in EC3 by selecting the EPDs for products procured.



26

The EC3 tool enables checking all of these boxes possible, today.

- ✓ **Require Environmental Product Declarations (EPDs)** for a specific list of construction materials
- ✓ **Utilize a free database of verified EPDs** to display all compliant EPDs
- ✓ **Set kgCO2e targets or limits** for a specific list of construction materials and require facility and product specific EPDs to demonstrate compliance.
- ✓ **Require project teams to submit project data** (material quantities and EPDs for installed products) for review and inclusion in benchmarking database.




27



Embodied and Operational Carbon:

Building Product Manufacturer Perspective



28



Quiz Question

According to the EU Science Hub, what % of a product's impacts are built in during design processes?

20%

40%

60%

80%

29



Quiz Question

According to the EU Science Hub, what % of a product's impacts are built in during design processes?

20%

40%

60%

80%

30

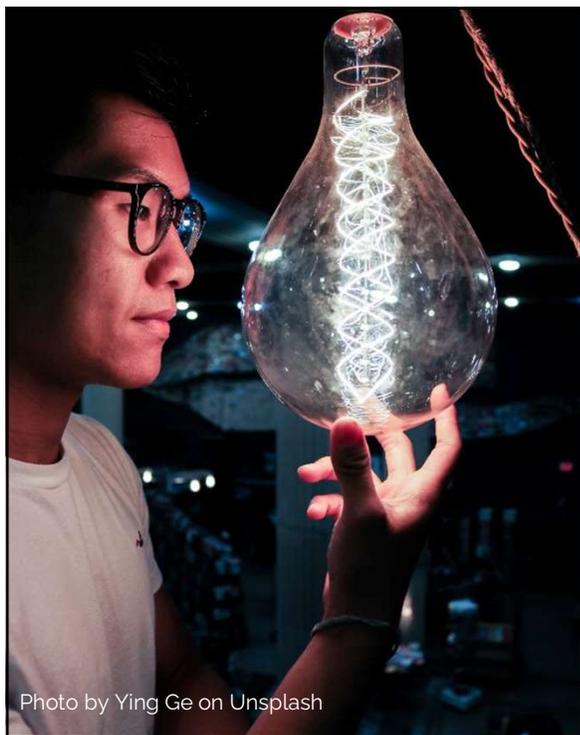


Photo by Ying Ge on Unsplash

The myth of innovation is that brilliant ideas leap fully formed from the minds of geniuses. The reality is that most innovations come from a process of rigorous examination through which great ideas are identified and developed before being realized as new offerings and capabilities.

Tim Brown

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Making the case for full life cycle thinking



33

Case Study: Peikko Deltabeam



page 34



Design for Sustainability



How do we make our materials work better for us?

- Provide differentiated product
- Create high performance material

How might you conserve materials and improve building performance at the same time?

PEIKKO DELTABEAM

The Deltabeam's shallow design decreases a building's floor-to-floor height, creating a multiplier effect in building material optimization. Also lowers heating and cooling costs by minimizing conductive losses.

34

Deltabeam and Embodied Carbon

Product has relatively low embodied carbon vs. other floor slab solutions, primarily due to lower overall mass:

- Unlike envelope area, amount of slabs scales linearly with internal area required.
- Reducing net thickness of slabs reduces building envelope height correspondingly.



Benefits extend to use phase:

- Reduced product mass; energy is conserved via lower conductive losses.

Complete systems view: better understand embodied carbon benefit potential

35

Case Study: Kohler Modflex Adjust-a-Bowl



WHAT IS IT?

Modflex is a retrofit solution for institutional wall-hung toilet bowls that provides safe load-bearing capability. It features a large footprint that masks wall and floor scarring from the previous installation and an adjustable waste trap that eliminates most modification plumbing work behind the wall.



Design for Sustainability



What is the problem you are trying to solve, what is the context?

- Provide safe institutional solution
- Reduce gutting, remodeling, and downtime
- Maintain ease of regular cleaning

In what completely new ways could the function be delivered?

DESIGN OF MODFLEX

Modflex Adjust-a-bowl utilizes a larger than typical vitreous ceramic body to increase the product's functionality as both a product upgrade and a more robust project solution for the working surfaces of a room.

page 36

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Modflex and Embodied Carbon

Product itself has higher embodied carbon than other solutions in the market:

- Mass of vitreous ceramic
- Adjustable wall outlet materials
- Packaging
- Transportation



From a complete systems view, it significantly lowers embodied carbon impacts:

- Floor and wall repair
- Associated demolition waste
- In-wall plumbing retrofit

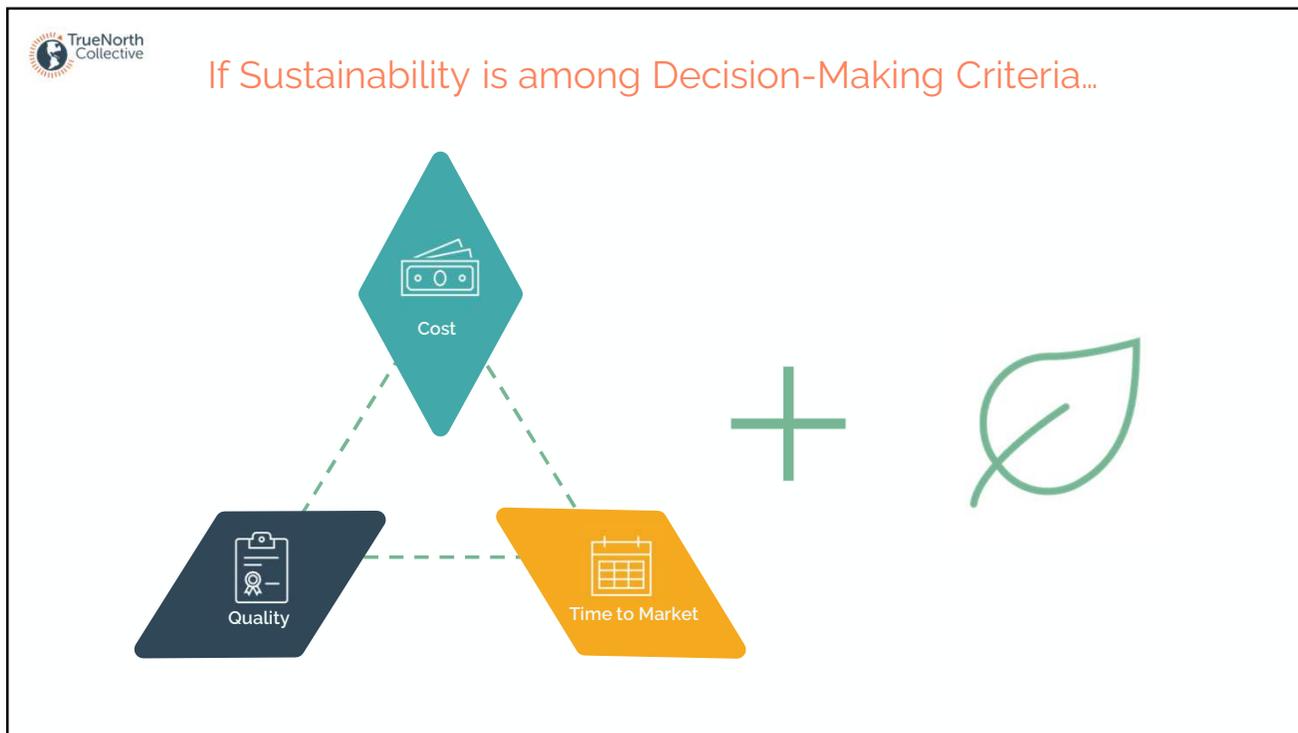
Understanding embodied C of the product itself doesn't tell the full story.
How can we avoid this trap?

37

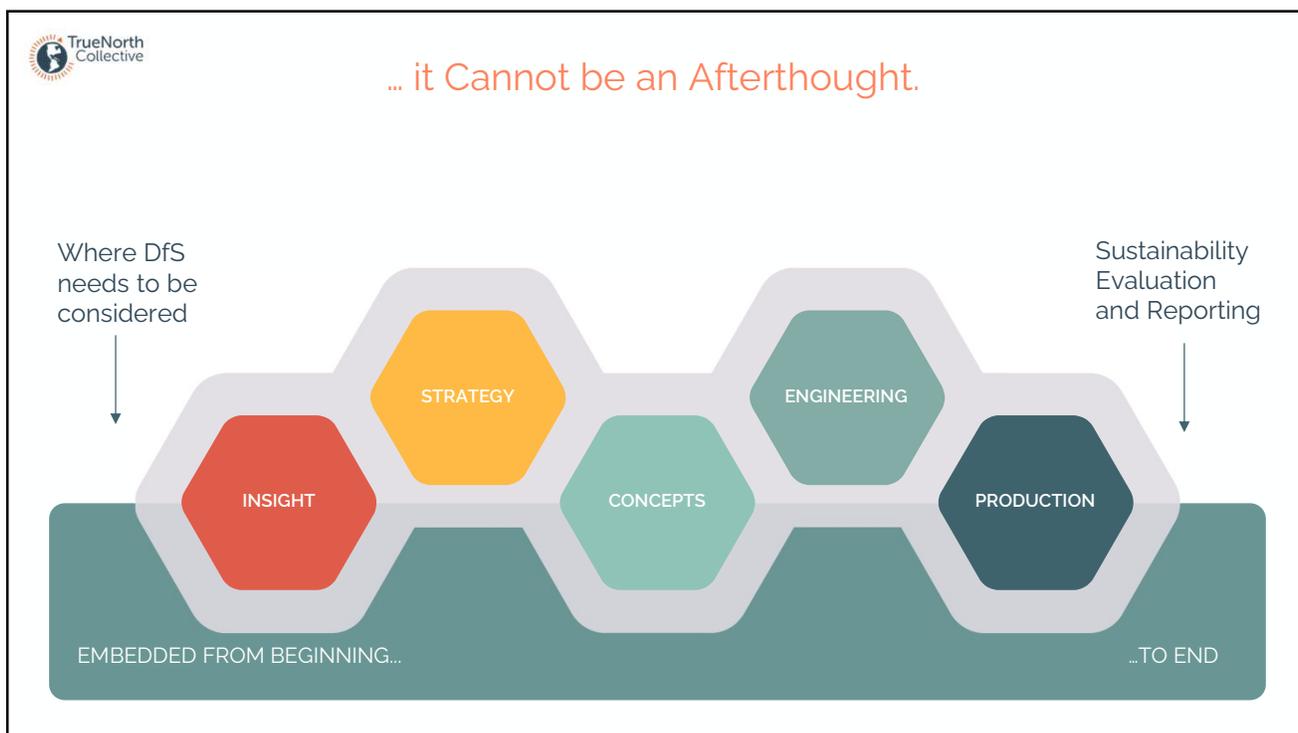


Getting Started.....

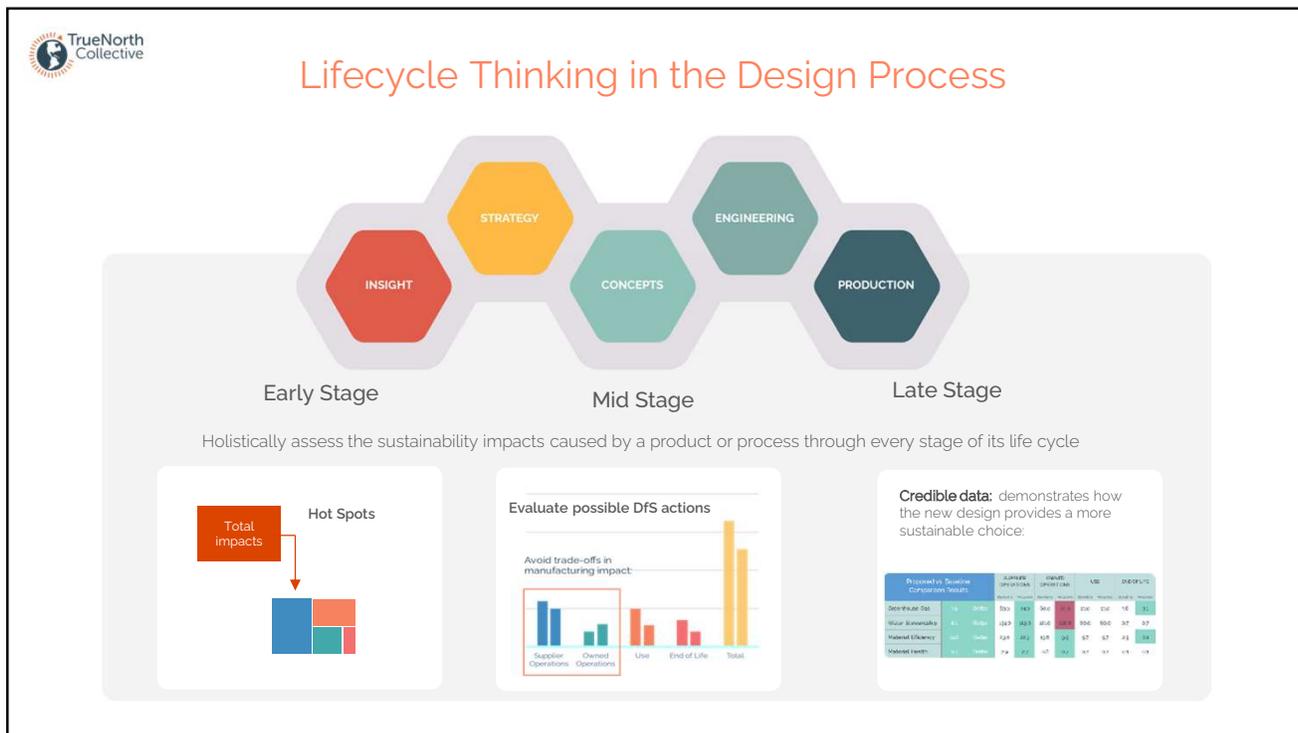
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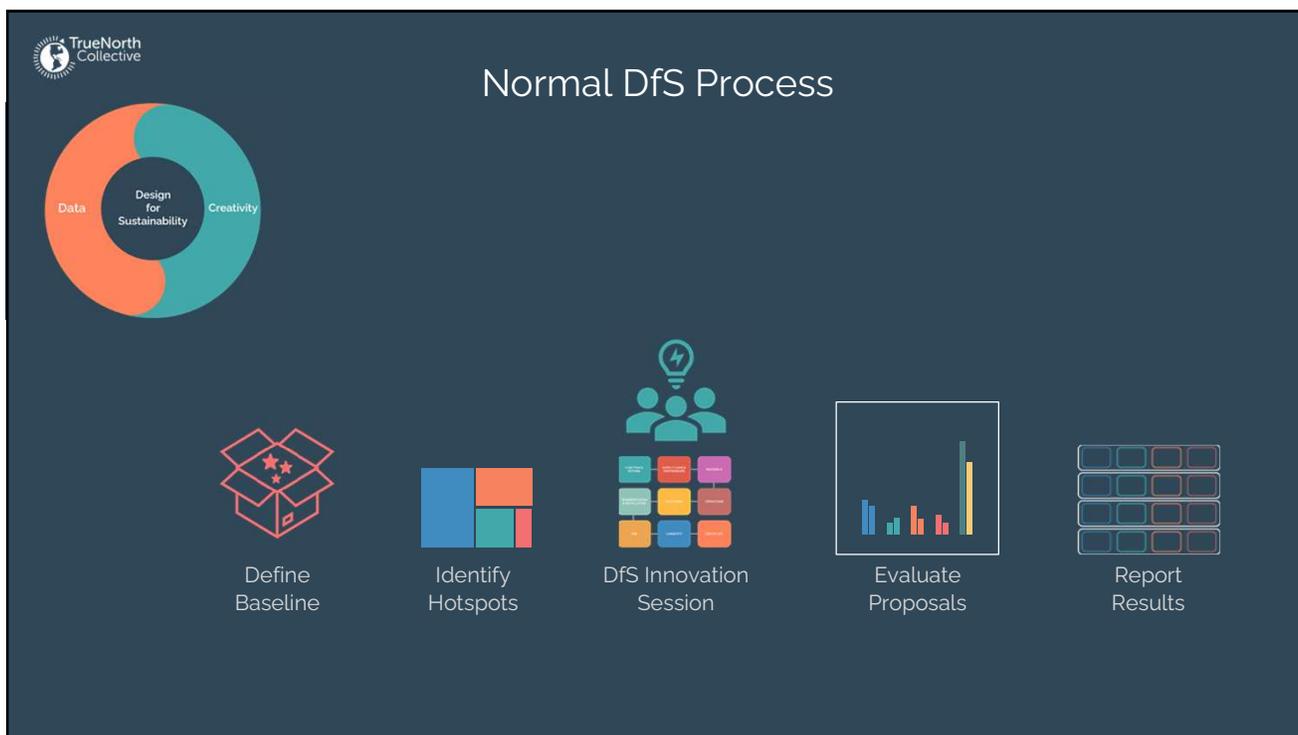
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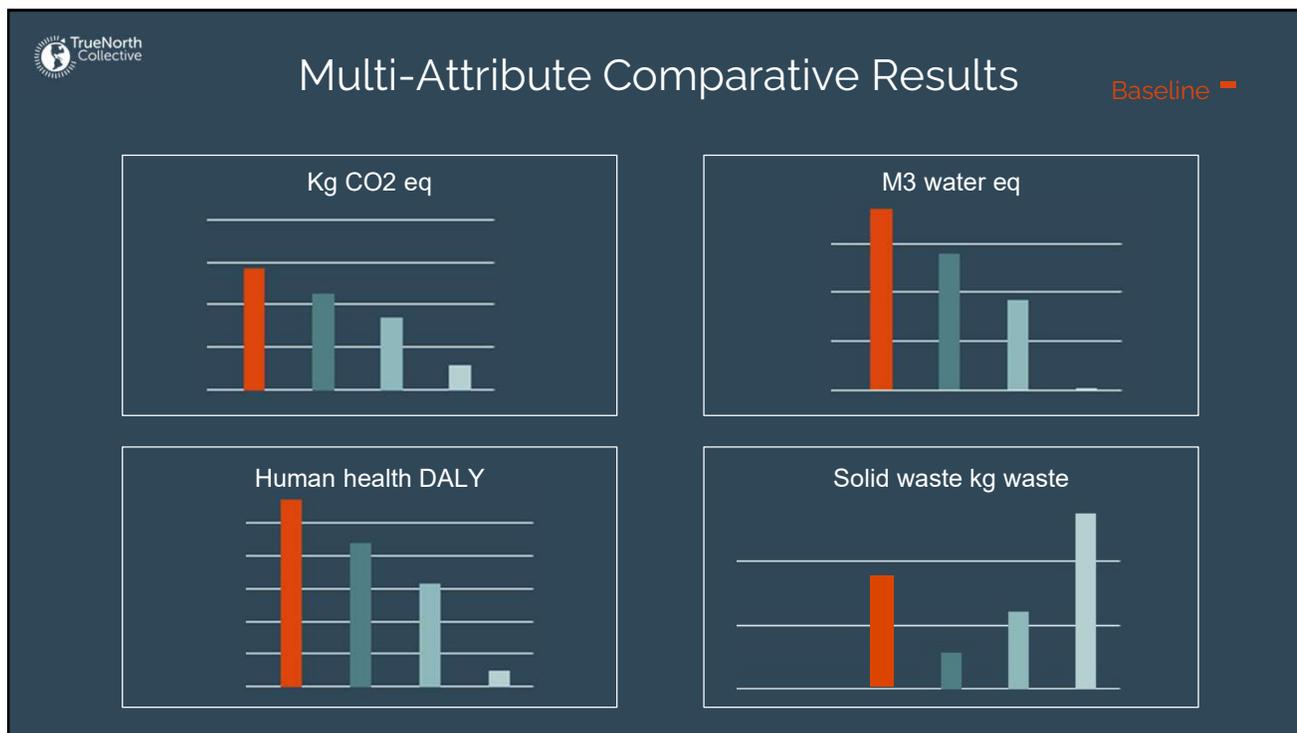
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41



42



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TrueNorth Collective

How can we test for the soul of more sustainable design?

- Establishment of sustainability metrics as part of decision making
- Clear commitment to Design for Sustainability as part of programming
- Seek out quantified, multi-attribute benefits based in life cycle
- Be skeptical of vague claims
- ...

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