Net Zero, Passive House, Embodied Carbon

Why Healthy Materials Are Essential to High Performing Building Designs

New Frameworks

integrated ecostrategy

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Learning Objectives

1. Identify where chemicals of concern exist using six classes approach

2. Explore the relationship/overlap between materials that support healthy indoor environments, and materials that have low embodied carbon values

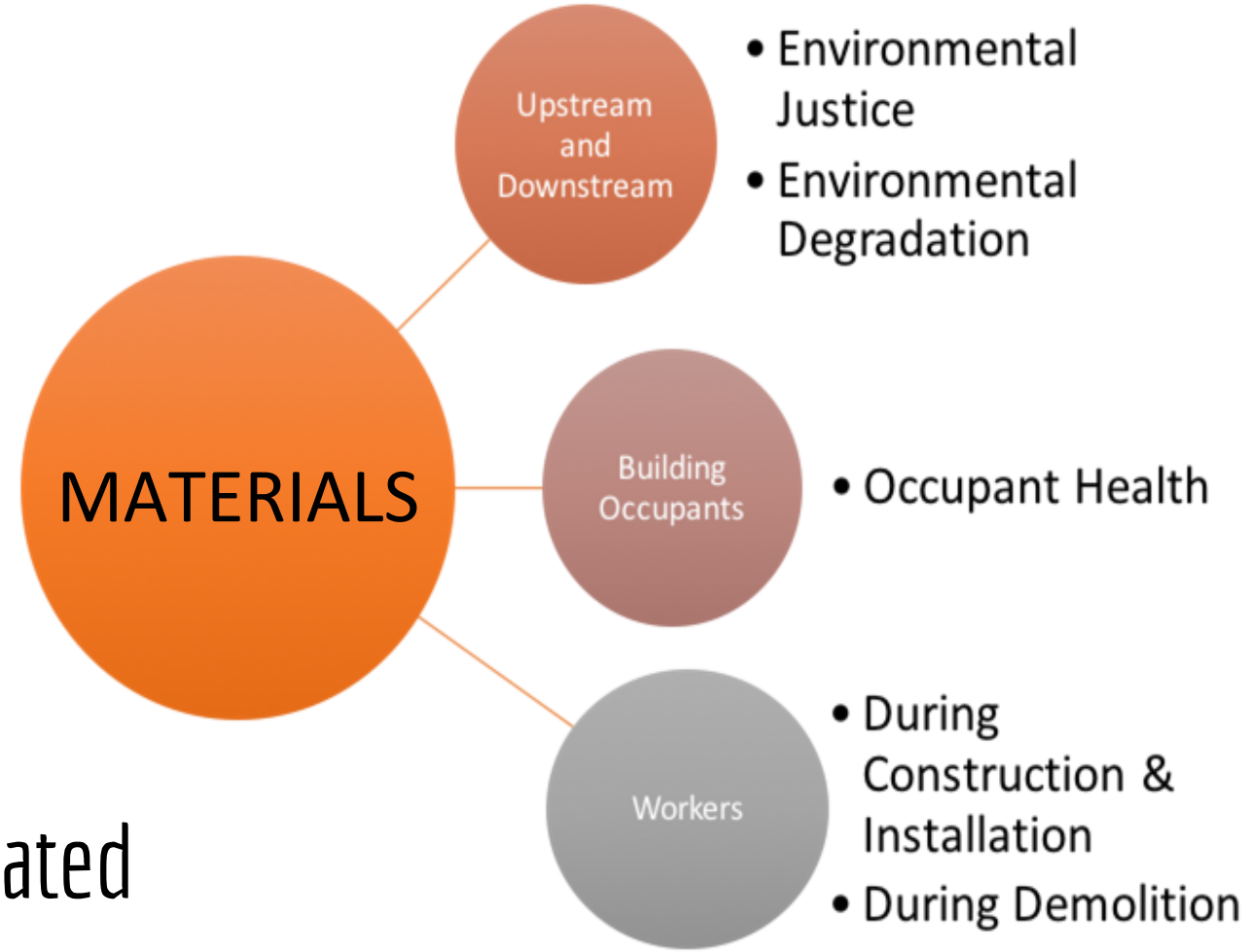
3. Understand the importance of material selection in high performance buildings, as evidenced in impacts on both occupant and environmental health and carbon footprint

4. Identify processes and goals for healthy buildings and for low carbon construction practices, and identify which material solutions best support these goals

Who are you?

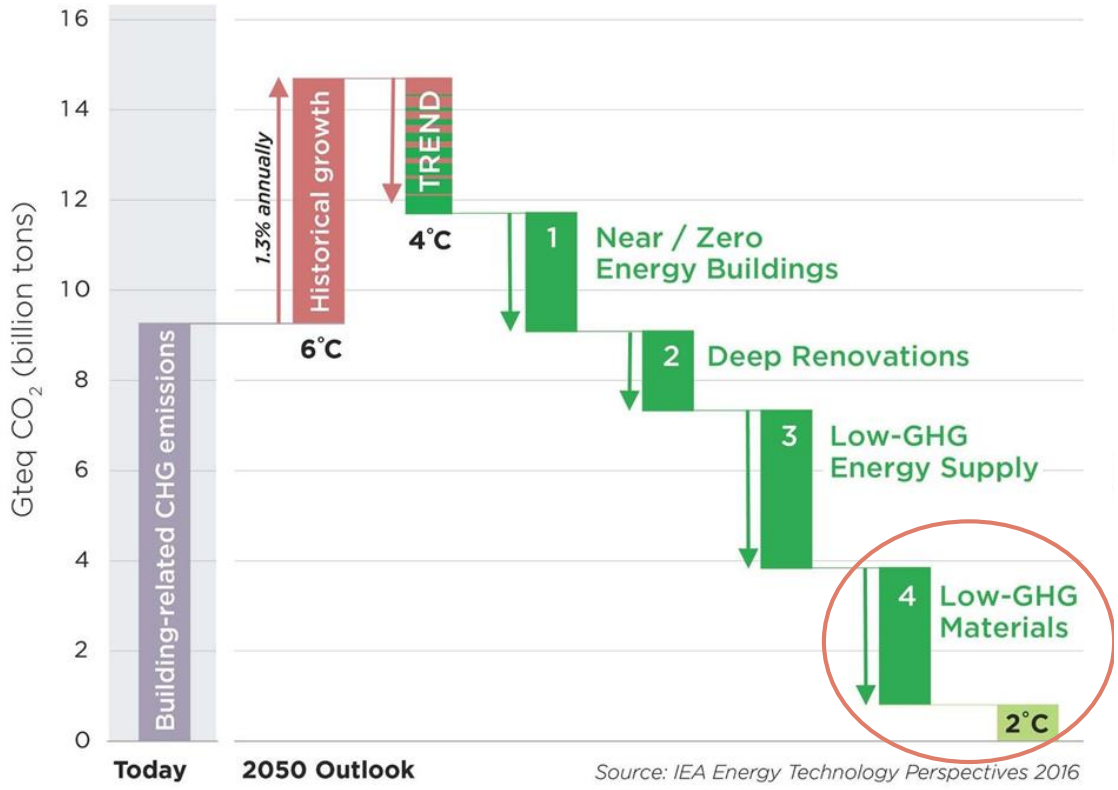
GOAL

Over time, all harms eliminated



Split of Global Building-related Emissions & Emissions Reduction Potential

4 Key global policy priorities for <2˚C Scenario



THE SIX CLASSES OF CHEMICALS OF CONCERN

1	2	3	4	5	6
Highly Fluorinated	Antimicrobials	Flame Retardants	Bisphenols + Phthalates	Some Solvents	Certain Metals






How to reduce your exposure to harmful chemicals
SixClasses.org

GREEN SCIENCE POLICY INSTITUTE

Health Impacts

Highly Fluorinated: Kidney and testicular cancer; elevated cholesterol; decreased fertility; thyroid disease; interference with hormone function. **Antimicrobial:** Developmental; hormonal; reproductive problems; antibiotic resistance. **Flame Retardants:** Lowered IQ and hyperactivity in children; cancer; hormone disruption; decreased fertility; **Bisphenols & Phthalates:** Mimic or block hormones disrupting vital body systems; asthma; neuro-developmental problems; allergies; cognitive problems; obesity; type II diabetes; heart disease; decreased fertility; prostate cancer; reduced fertility. **Solvents:** Neurological problems and increased cancer risks. **Certain Metals:** Mercury/Arsenic/Cadmium and Lead exposure can cause brain development to be impacted; increase risk of cancer; neurological and cardiovascular effects; lung and kidney damage.

1. Highly Fluorinated

Where are they?

Stain & Water Repellents

- Furniture upholstery
- Carpets
- Drapery

FEP/teflon insulated Wire and Cable

Metal coatings “PVDF” type

Health + Carbon:

Eliminate products that need water and stain repellents; look to polymers that don’t contain perfluorinated compounds

2. Antimicrobials

Where are they?

Wall and window finishes
Flooring
Surfaces in lav & kitchen areas
Acoustical ceiling comp. & panels
Polyurethane adhesives
Foam and cellulose insulation

Health + Carbon:

NO Triclosan, triclocaraban, halogenated aromatics, nanosilver and "quats." Elimination of material ingredients is better, as you can eventually eliminate the marketplace.

See: Building Green "*Antimicrobial Chemicals in Buildings- Hygiene or Harm?*"

3. Flame Retardants

Where are they?

- Furniture Foam
- Building Insulation
- Textiles
- Fabric blinds and drapes
- Paints and coatings
- Wire and Cable sheathing
- Electronic Cases

Health + Carbon:

Design/Build without foam insulation and products that contain these harmful chemicals.

TB 117-2013 for Furniture = meet flammability standards without chemical flame retardants

4. Bisphenols & Phthalates

Where are they?

Add strength and flexibility to plastics…..

Bis: Polycarbonates used for electrical enclosures, luminaire lenses, furniture/cabinets, epoxy products (paints, grouts, surfaces)

Phthalates: Vinyl Flooring, plastic divider curtains, plastic filters and screens, glues, caulks, paints.

See: HBN's DataCommons: https://commons.healthymaterials.net/home and
LBC's Red List: https://living-future.org/declare/declare-about/red-list/#red-list-cas-guide

Plastics that are “better” for Health + Carbon

PET (#1 recycled) **is recycled** to make new PET bottles or spun into **polyester fiber** that can make carpets, stuffing for furniture, and small pieces for a range of items from light fixtures to plumbing components;

HDPE (#2) is very stable, can be used to make everything from wastewater pipe to baby changing stations. Durable when exposed to the elements. **Simple to recycle for secondary use. Substitute for PVC** where code allows.

For Cable: Polyolefins, Modified polyphenylene (mPPE). **Highly recyclable and less material needs to be used.**

5. Solvents

Where are they?

They disperse or dissolve...

- Oil based paints
- Adhesives
- Sealants
- Blowing Agents for foam

Health + Carbon:

Eliminate products that have harmful solvents--CA Class II Banned list.
Water based products.
Mechanical fasteners (better for adaptation/deconstruction)

https://www.arb.ca.gov/db/solvents/solvents.htm

6. Certain Metals

Mercury, Arsenic, Cadmium and Lead

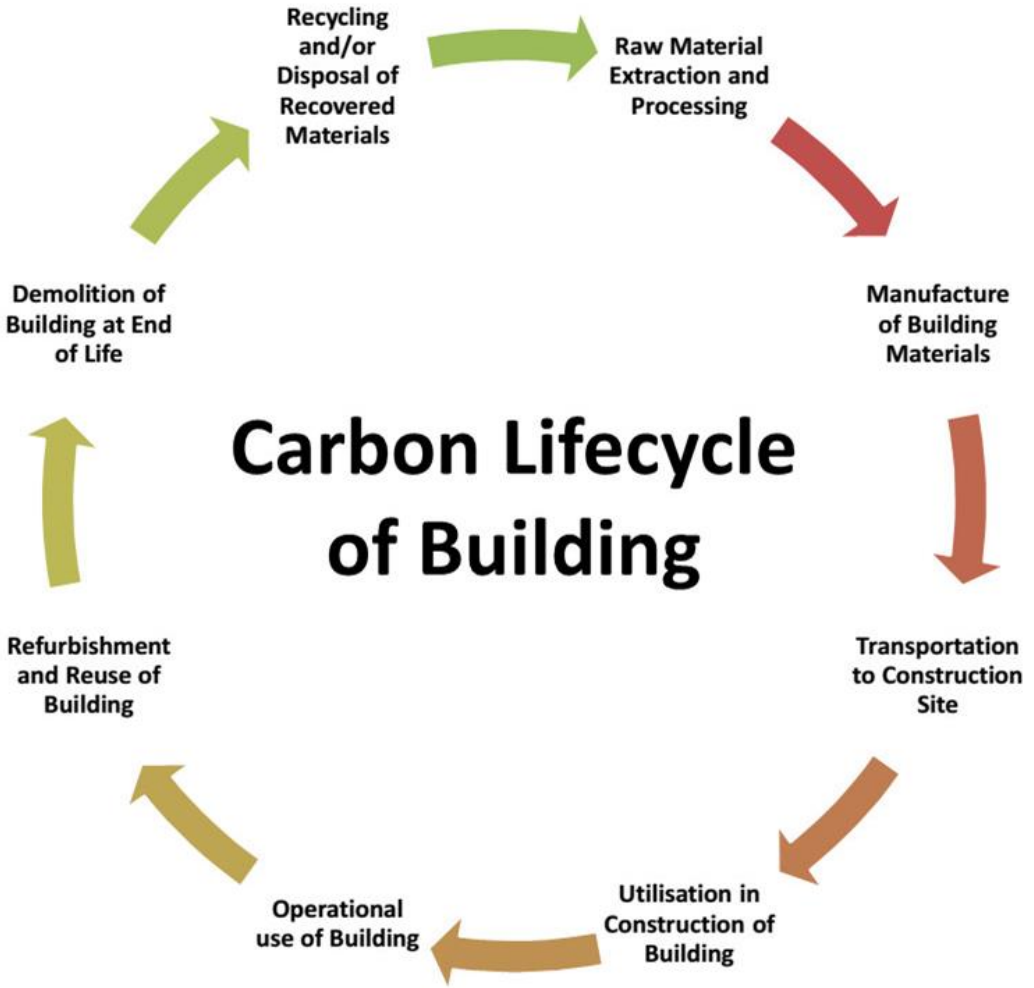
Where are they?

Plumbing & HVAC Lead in equipment that is not covered by the SDWA
Drywall (trace mercury)
Electronic products (M, C & L)
Cadmium: paints, metal coatings.
CRVI in galvanized and plated

Health + Carbon:

Lead Free or low-lead for non-potable fixtures and fittings;
Recycled content gyp board has trace mercury but best for eCO2!
Electronics that have RoHS & WEEE recycling; CRIII for galvanizing and plating.

What is **embodied carbon**?

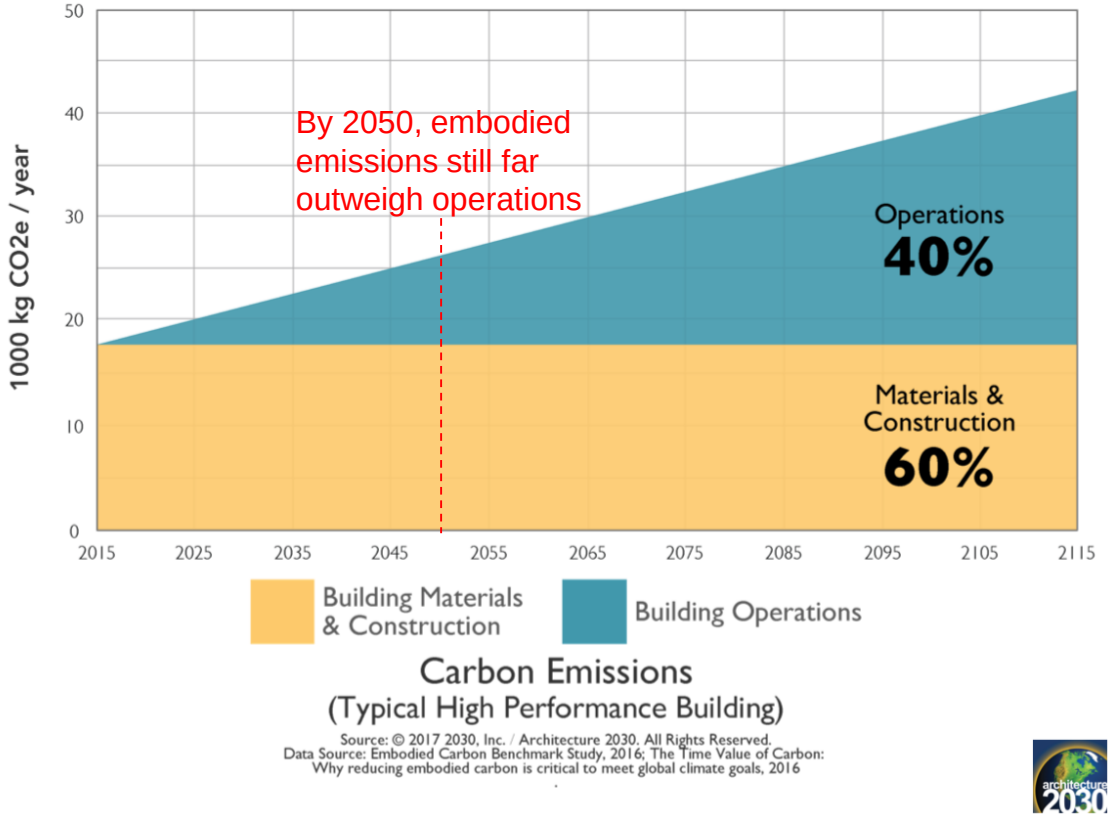


Why does embodied carbon (eCO2e) matter?

1. Cannot reach WGBC “zero by 2050” goal **without addressing eCO2e.**

2. Embodied emissions are large, and immediate - **timing is critical, cannot be offset**.

3. As **grid “de-carbonizes”**, operational CO2e reduces.



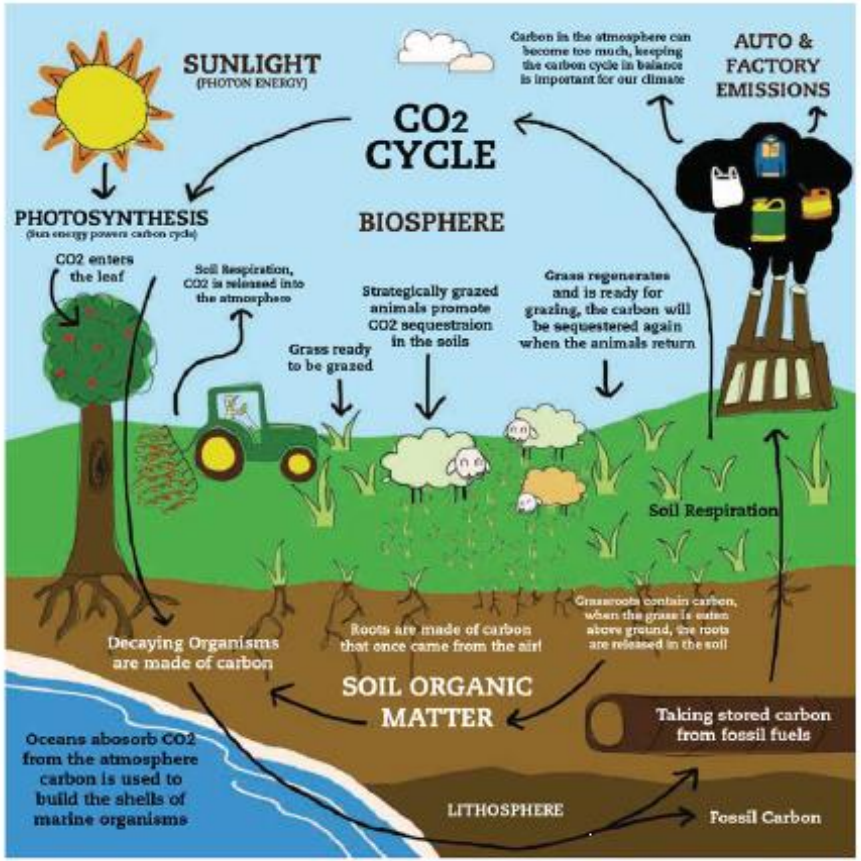
Why does embodied carbon (eCO2e) matter?

4. High eCO2e insulation may result in **more net emissions than less insulation.**

5. Carbon-storing materials can help **reverse atmospheric CO2e load**.

6. Plant-based materials can amplify **carbon-smart silvi/agriculture.**

7. Plant-based materials can support **carbon-smart economies.**



We know we can get to net zero.....

Image Credit: Edwin Dehler-Seter

Measuring Carbon

Carbon Databases – databases populated with embodied carbon values for various materials; data generally not normalized to useful units and may not be directly comparable between different materials.

Environmental Product Declaration (EPD) – a document that communicates verified, transparent and comparable information about the life-cycle environmental impact of products, including the embodied CO2e. Caution: units and methodologies may vary widely!

Whole Building Life Cycle Analysis (WBLCA) – a technique that identifies, quantifies and evaluates the environmental impacts (inputs and outputs) of a building from cradle to grave/cradle.

Example: Expanded PolyStyrene (EPS)

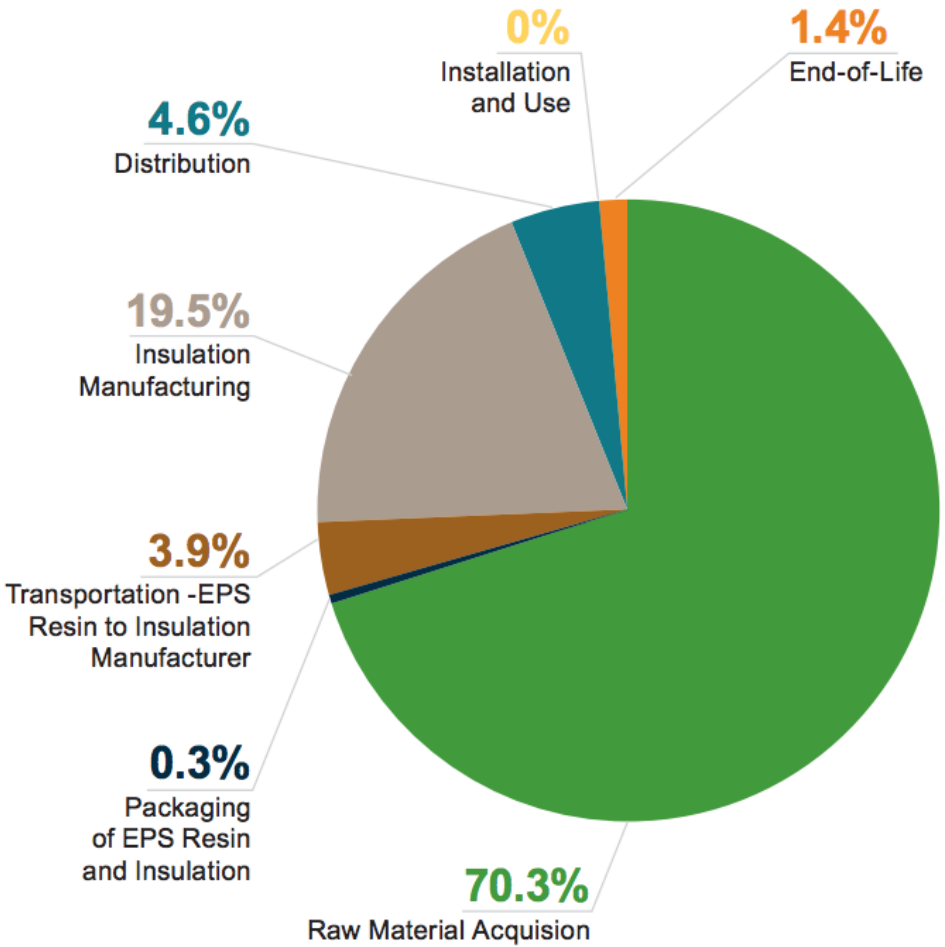
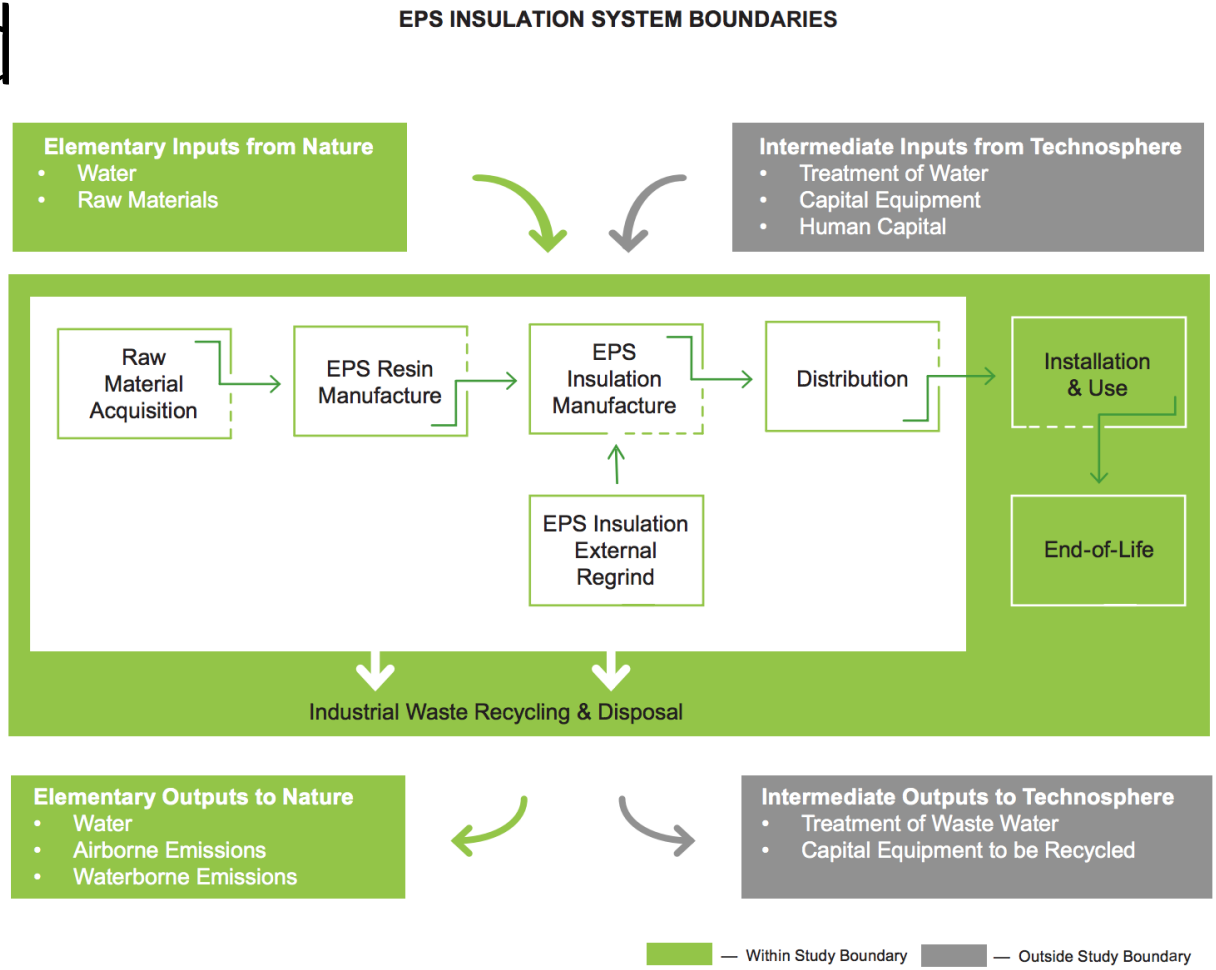


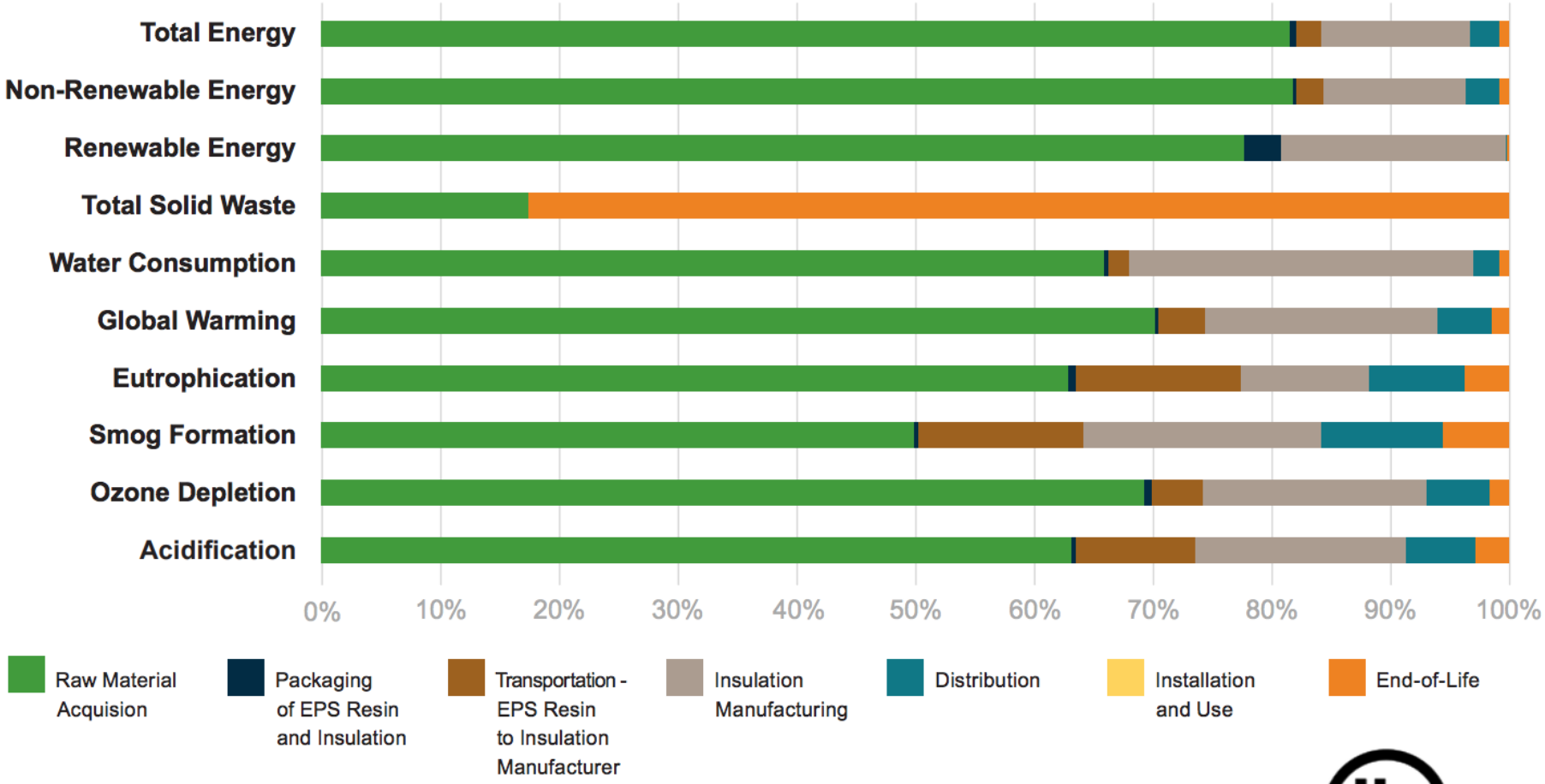
Figure 4: Global Warming Potential Results for EPS Insulation

Source: industry EPD

Example: Expanded PolyStyrene (EPS)



Source: industry EPD

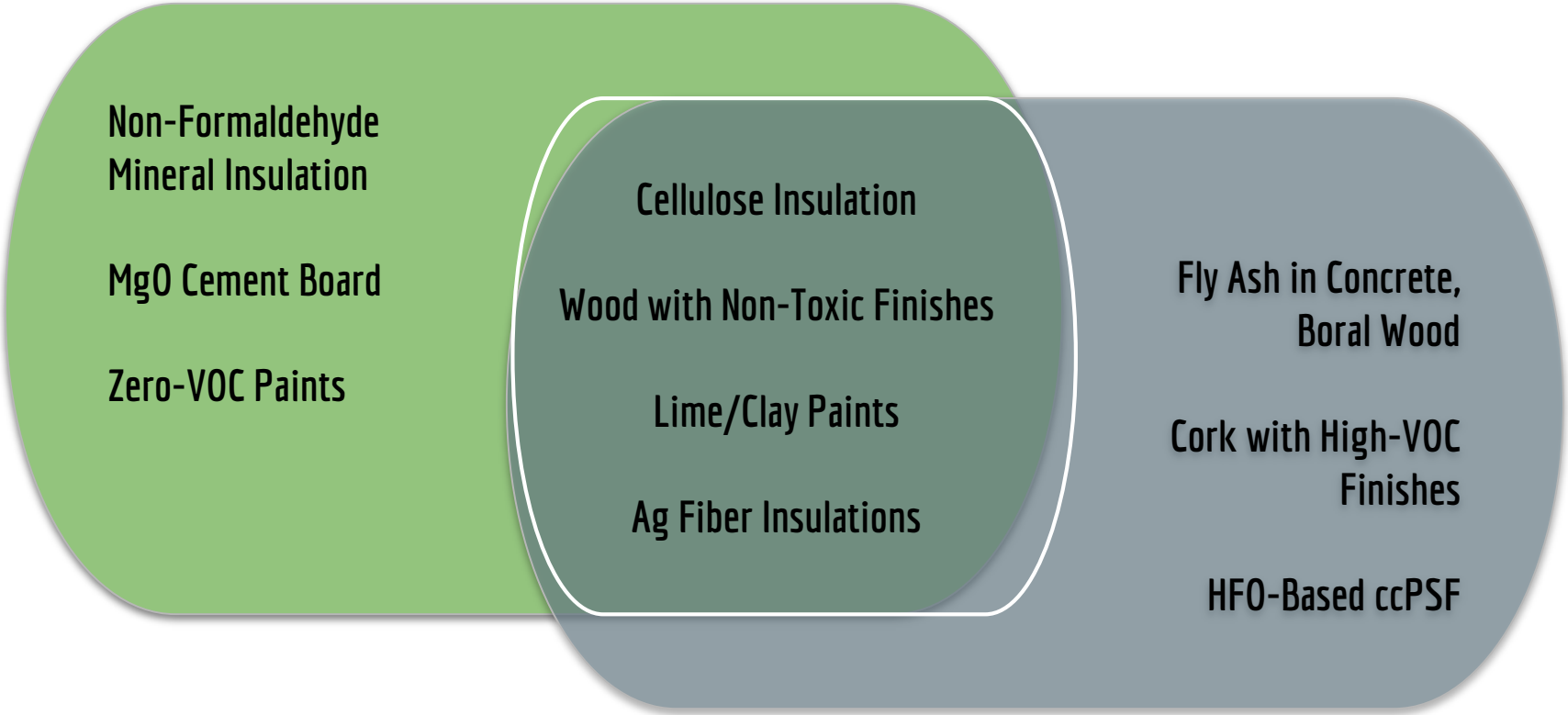


Environment

Figure 7: Normalized Results for EPS Insulation

Materials and Methods [15-20 min]

Health + Carbon: Material “Sweet Spot”



Structure

	Baseline	Better	Best
Material Type	Standard Portland Cement, virgin steel	Fly-ash concrete, recycled steel	CO2-cured concrete/reduction strategies, wood*
Impact	*High eCO2e, toxic treatments (CR6 or PFOAs), emissions (i.e. mercury)*	*Lower eCO2e, toxins in fly ash and treatments*	*Lowest carbon/carbon storing, non/low toxic***

*FSC or comparable management practices must be applied. Use reclaimed wood where feasible.
**Avoid Phenol formaldehyde in adhesives used for laminated timbers, MDF; toxins in wood treatments

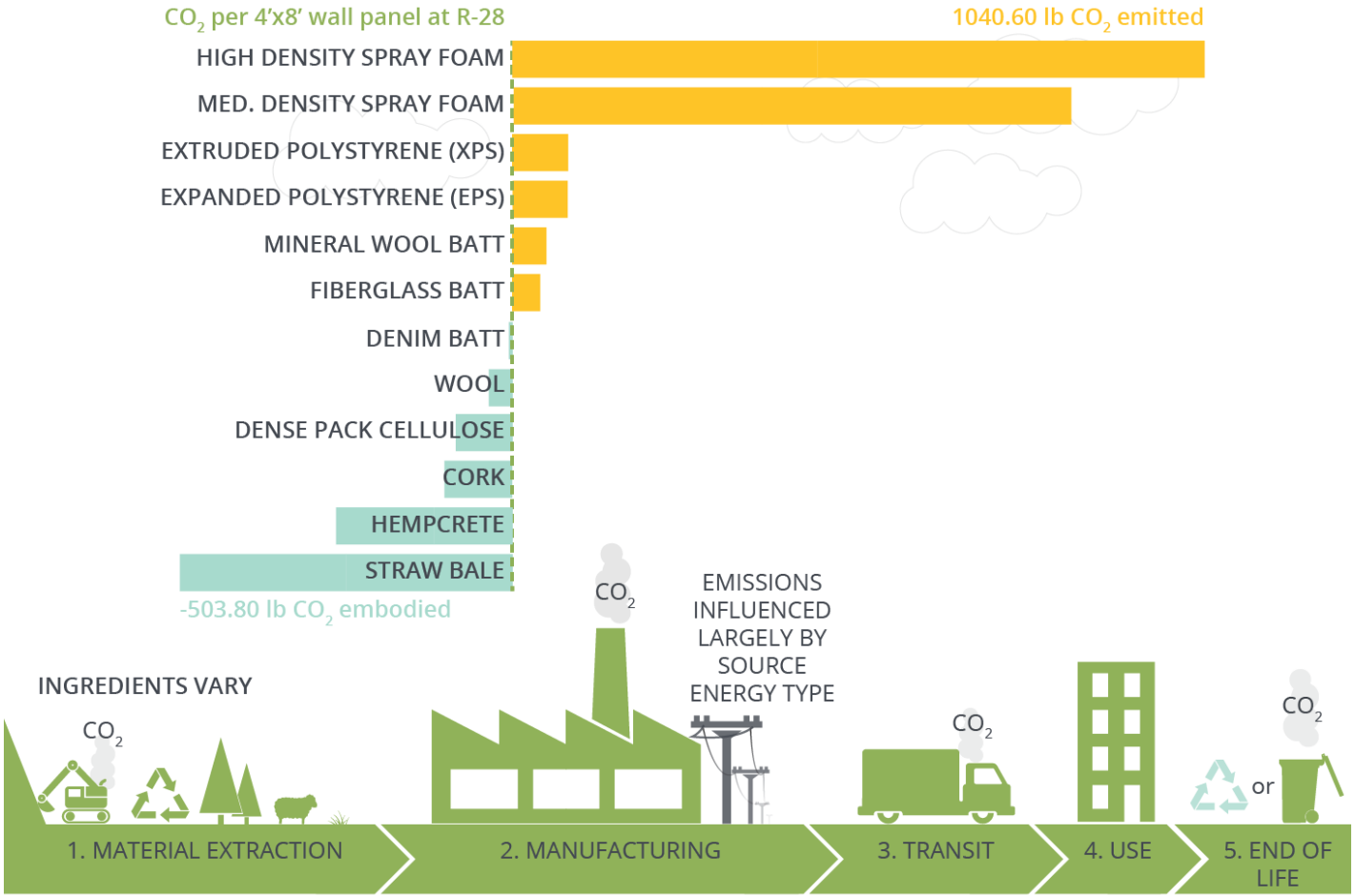
Insulation-Rigid

	Baseline	Better	Best
Material Type	XPS	Mineral Board Polyisocyanurate (PIR)	Fiber Board Hempcrete++
Impact	*High eCO2e, Flame Retardants*	*Less toxic, high carbon* *PIR is lower carbon, moderately toxic*	*Lowest carbon/carbon storing, non/low toxic***

++ While not a rigid board, a rigid insulation once it cures

**Avoid Phenol formaldehyde in adhesives used for the fiber board products

CARBON IMPACTS OF INSULATION



Carbon impacts data sources: "Making Better Buildings", Chris Magwood, 2016; SPFA Industry Average Environmental Product Declaration, Number 13CA29310.101.1, 2013

Finishes-Of ALL Types

ASK:
What do
I need?

AT THE VERY LEAST….Is the product or material recyclable or can it be repurposed? What is the likely “end of life?”

Material Health Assessed!

HPD +/ C2C 3.1 w/Mat’l Health +/
Declare Red List Free or RL Compliant

Embodied Carbon Considered!

Find companies that have completed EPD’s, or done some level of LCA.

Example: Carpet Tile (Interface)

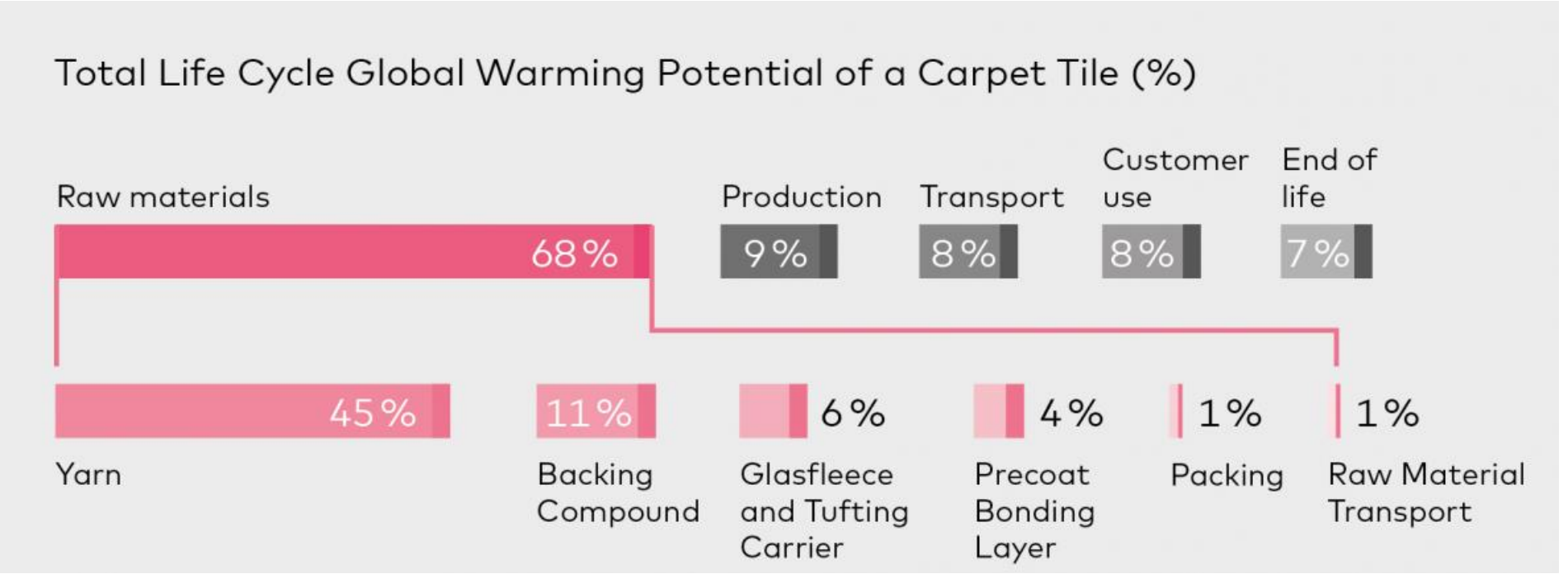
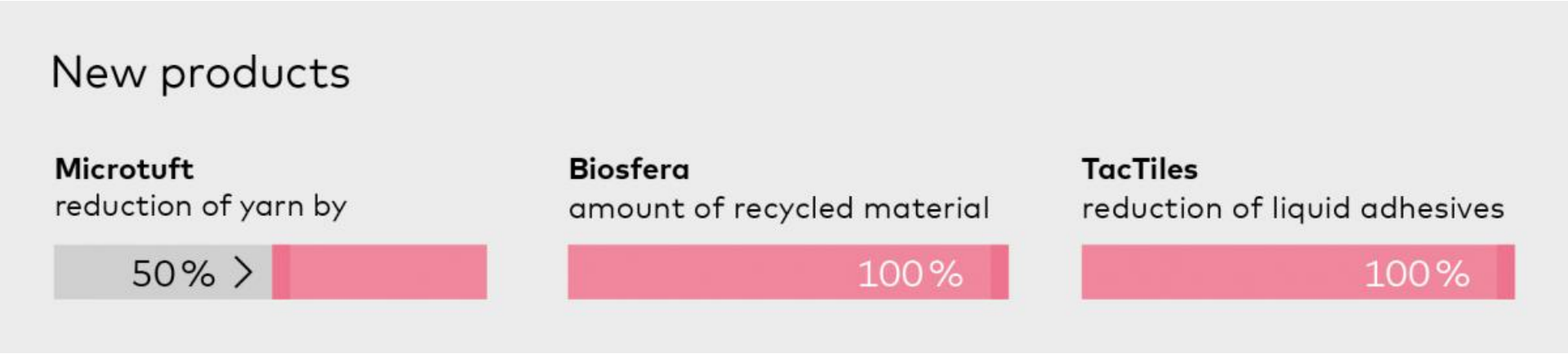


Image Source: thinkstep assessment of Interface via GaBI software

Elimination or reduction of raw materials leads to more optimal solutions….



Where are these opportunities in ANY of the products you specify?

Image Source: thinkstep

Product Certifications: Example Gypsum Board

38

38

37+ Declare Labels

61 HPDs

200+ Emissions Tested

16 EPDs

Questions?

Strategies and Practices [25’ min]

Group Exercise!

Address how we can get to healthier materials and better carbon outcomes via:

- Process/Project organization
- Design strategies
- Tools/metrics
- Other?

Project Organization

- Engage the whole team - importance of IPD and/or stakeholder buy-in
- Goal setting and evaluation during conceptual/schematic design
- Partner with vendors and manufacturers and OTHER projects in order to achieve economies of scale for preferential products.
- Make project material goals public: commitment to exceed 2030; Commitment to AIA's 2050 Materials Pledge, Paris agreement.....
- Establish the metrics (see below) and framework for tracking progress

Design

- Ask: Do I need it? If so, how can it adapt over time to serve multiple functions?
- Design to deconstruct!
- Simplify palette; Architecture 2030 Carbon Smart Materials Pallet
- What are your goalposts (see previous)?
- Pick a CSI section and begin there!
- Residential vs. non-residential projects and approaches
- Collaboration/organizations that pull projects together

Metrics

- Don’t get stuck on quantifying absolute values of carbon, the numbers can be confusing but patterns can emerge.
- Look at whole building to identify “hot spots”, or look at comparative analysis to make specific choices (if data is there to compare). Look for big patterns to make easier decisions (i.e. build with plants whenever possible).
- Look at whole embodied carbon: anything that extends viability of materials e.g. single stream PE.

Tools: Health

Declare-Ingredient disclosure. RL Free and RL Compliant. Self reported or verified

Living Product Challenge- “Handprinting” Full LCA, as well as social justice component.

Healthy Hospitals Initiative (HHI). No list. Manufacturers confirm compliance. HPDs- varying levels of disclosure. No “judgement”. Self reported or

Tools: Health continued!

C2C Certified Product Standard 3.1-with Material Health Score Gold/Platinum. No transparency. IF Platinum for Renewable Energy/CO2 Management, some benefits for carbon

BiFMA Level 3-Stay tuned! For Furniture related products. Ask for scorecard to verify

Healthy Building Network Resources for education, chemical information/trends and guidance:

Pharos FROM HBN

DataCommons FROM HBN

HomeFree FROM HBN

Tools: Carbon

Athena Sustainable Materials Institute

tally™ ENVIRONMENTAL IMPACT TOOL

UNIVERSITY OF BATH

Autodesk “Tally”: + within Revit Model/ - WBLCA

Athena Impact Estimator: Free WBLCA tool

Bath Inventory of Carbon and Energy (ICE): + tried and true/ - new version coming Q1 ‘19

Building for Environmental and Economic Sustainability (BEES): + North American data

EPDs: + data sheet featuring verified life cycle data, including GWP / – units and methodologies will vary, use with caution especially in comparative analysis!

Parting thoughts…..

- **Transparency IS here to stay**, but understanding information a large task. Educate yourself, and start with the products that are most prevalent in your building.
- Energy is not a proxy for carbon, and carbon is what matters to the climate. Efficiency isn't enough - **we can't get there by reducing energy alone**! *Set carbon goals and a process for design and evaluation to meet these goals.*
- We need **better metrics and data** for assessing both ingredients and carbon! *Advocate to manufactures that we need this info.* In the absence of a clarity, **we can't afford to do nothing!**

Let's Talk Again.....

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