EMBODIED CARBON & LEED

Wes Sullens

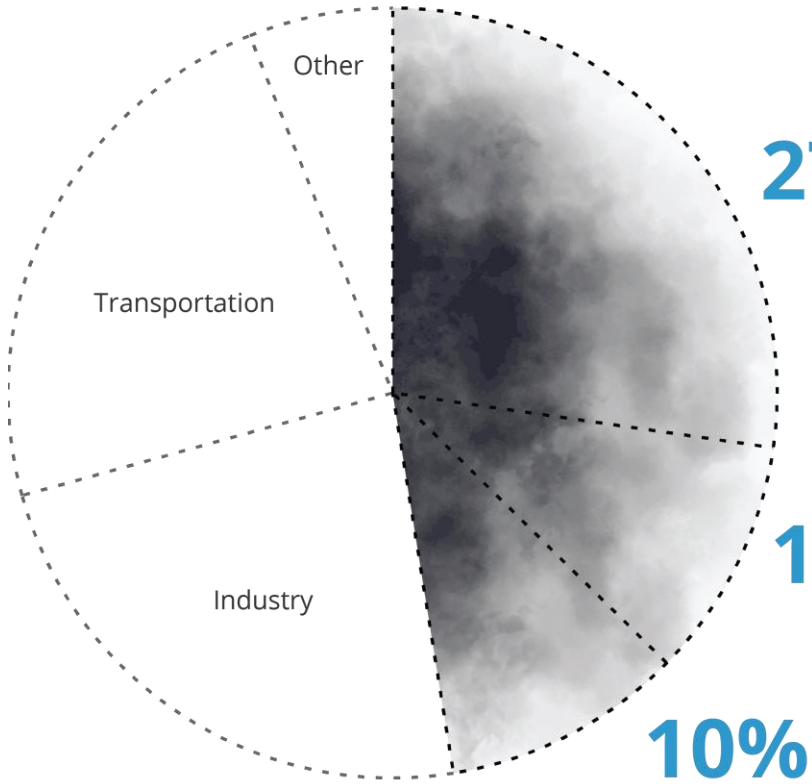
Director, LEED

NASEO Buildings Committee Meeting

September 19, 2023

IMPACTS OF EMBODIED CARBON AND MATERIALS

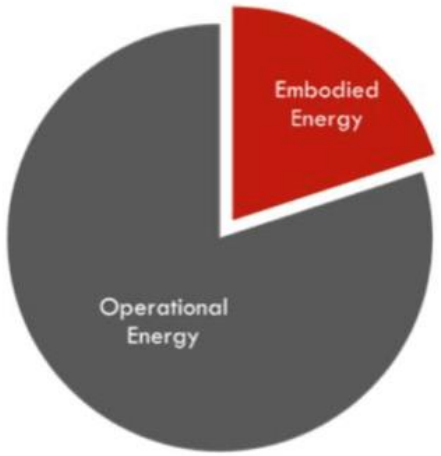
Annual Global CO_2 Emissions



27% BUILDING OPERATIONS

10% BUILDING MATERIALS & CONSTRUCTION

10% OTHER CONSTRUCTION INDUSTRY



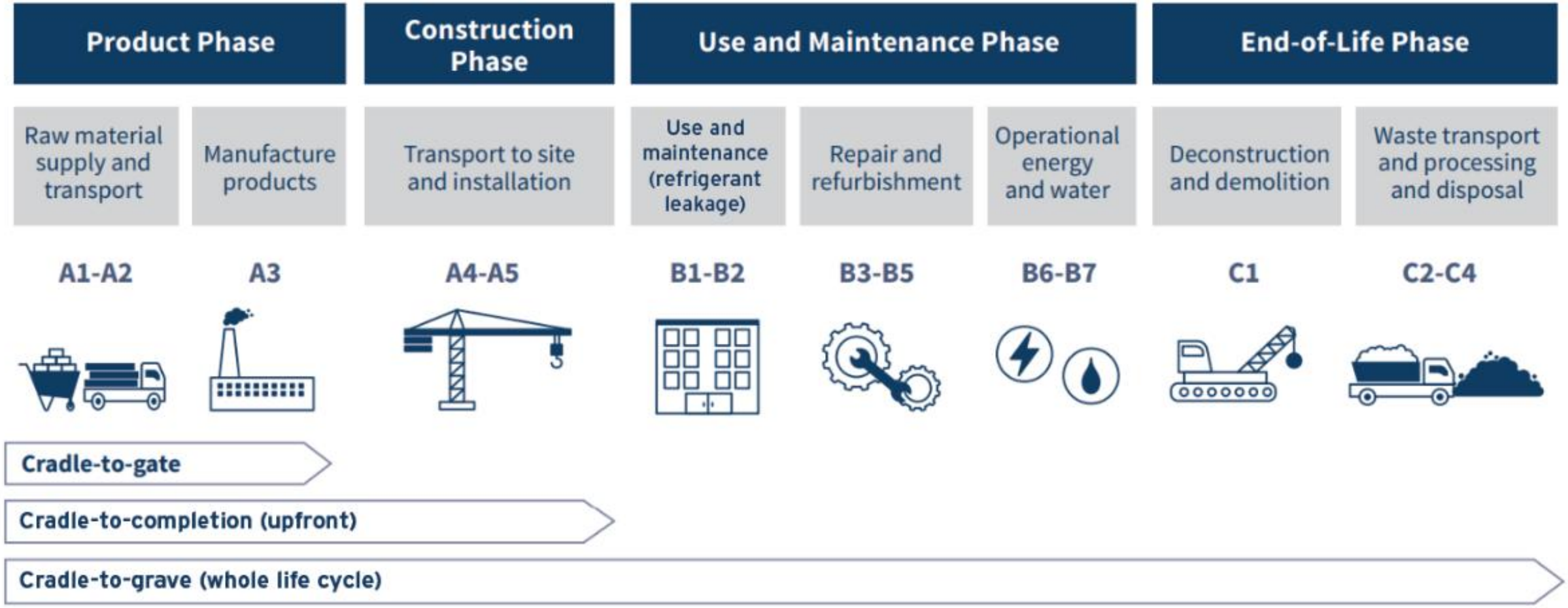
Typical Building

High Performance

©K. Simonen 2014

Data Sources: Global ABC Global Status Report 2021, EIA

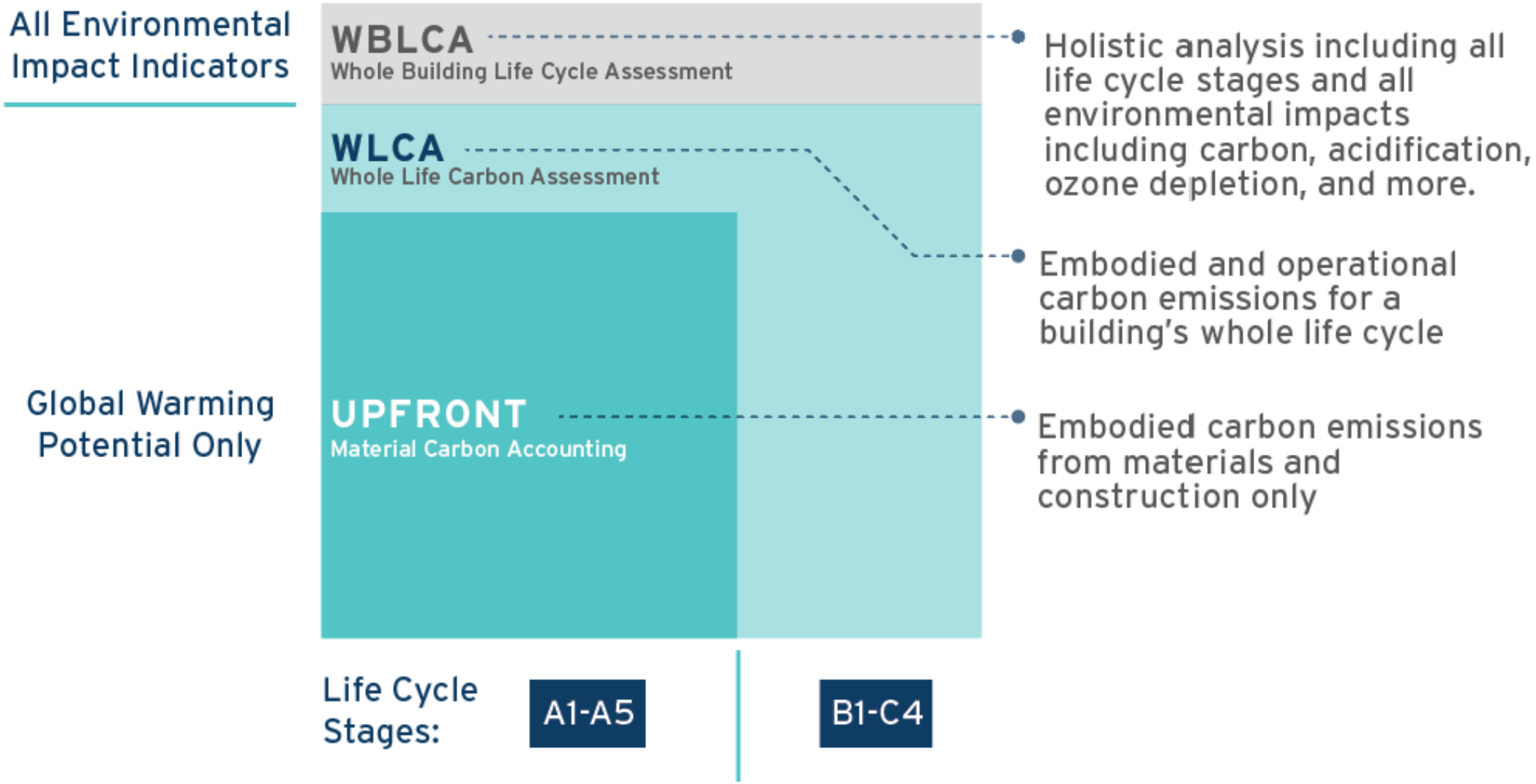
Life Cycle Assessment Stages



Life cycle impact categories:

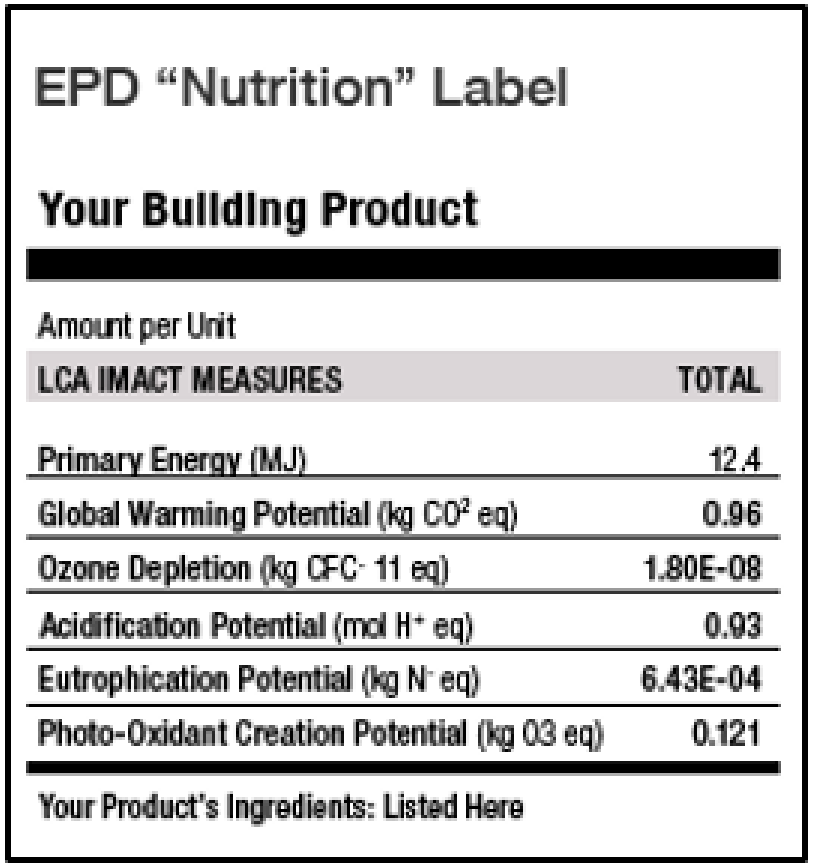
Global Warming Potential (embodied carbon), eutrophication, ozone, smog, acidification, Depletion of nonrenewable energy resources, ecotoxicity, land use change, etc.

Types of Whole Building Life Cycle & Embodied Carbon Assessments



Environmental Product Declarations

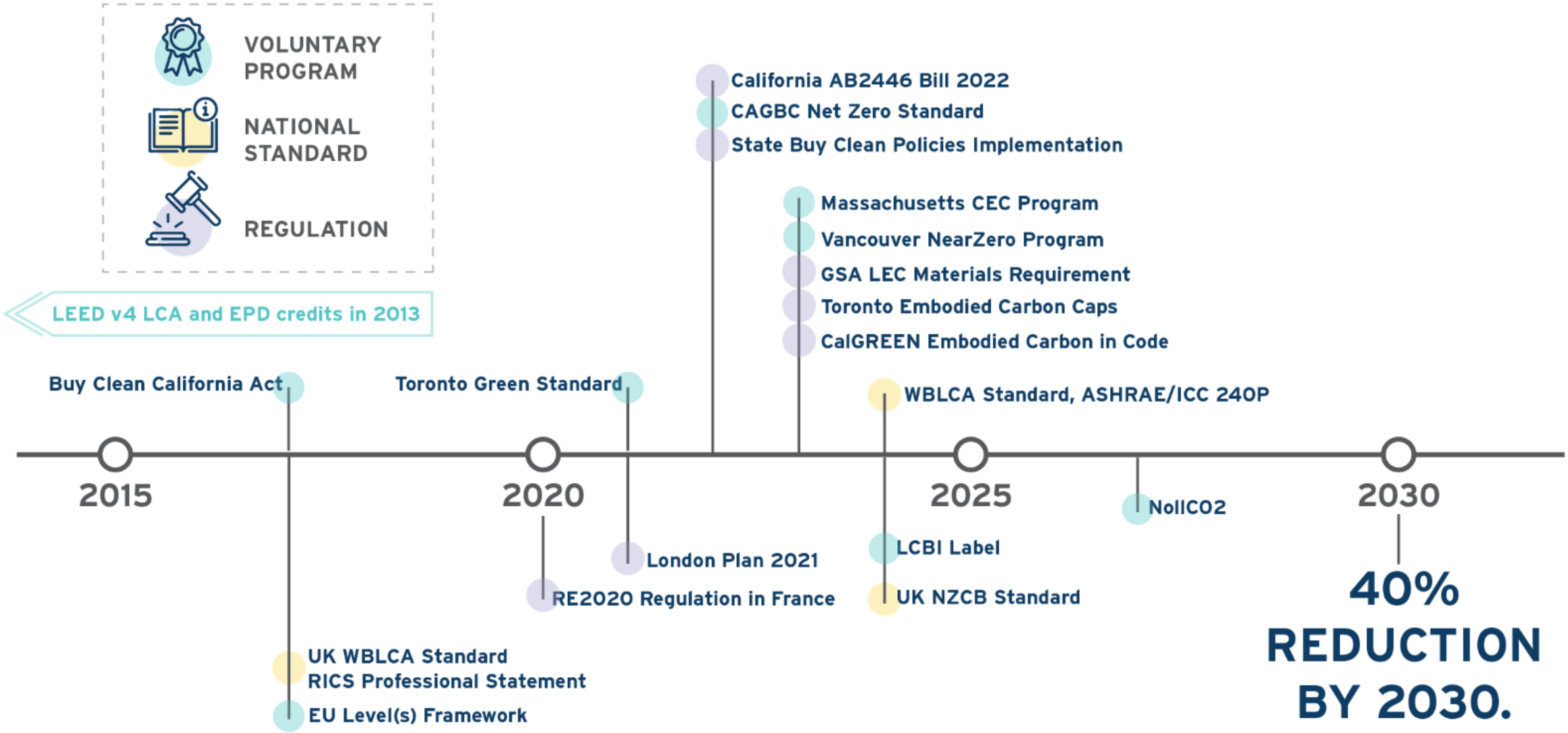
- ”Nutrition Label” for products
- Cradle-to-gate or Cradle-to-grave
- Reports life cycle impacts:
  - Global Warming Potential (embodied carbon)
  - Eutrophication (excessive nutrients in waterways)
  - Depletion of the stratospheric ozone layer
  - Acidification (acid rain)
  - Tropospheric ozone formation (smog)
  - Depletion of nonrenewable energy resources
  - And more!
- Parameters for life cycle analysis are defined by Product Category Rules (PCRs)



EMBODIED CARBON LEARNING CURVE

WE MUST ACCELERATE OUR POSITION ON THIS CURVE TO MEET CLIMATE THRESHOLDS. NOW IS THE TIME TO ACT.

Embodied Carbon Policy Landscape



Evolution of LEED

LEED v1.0-2.2
1998-2009
Strategy based

LEED 2009
2009-present
Analytically weighted

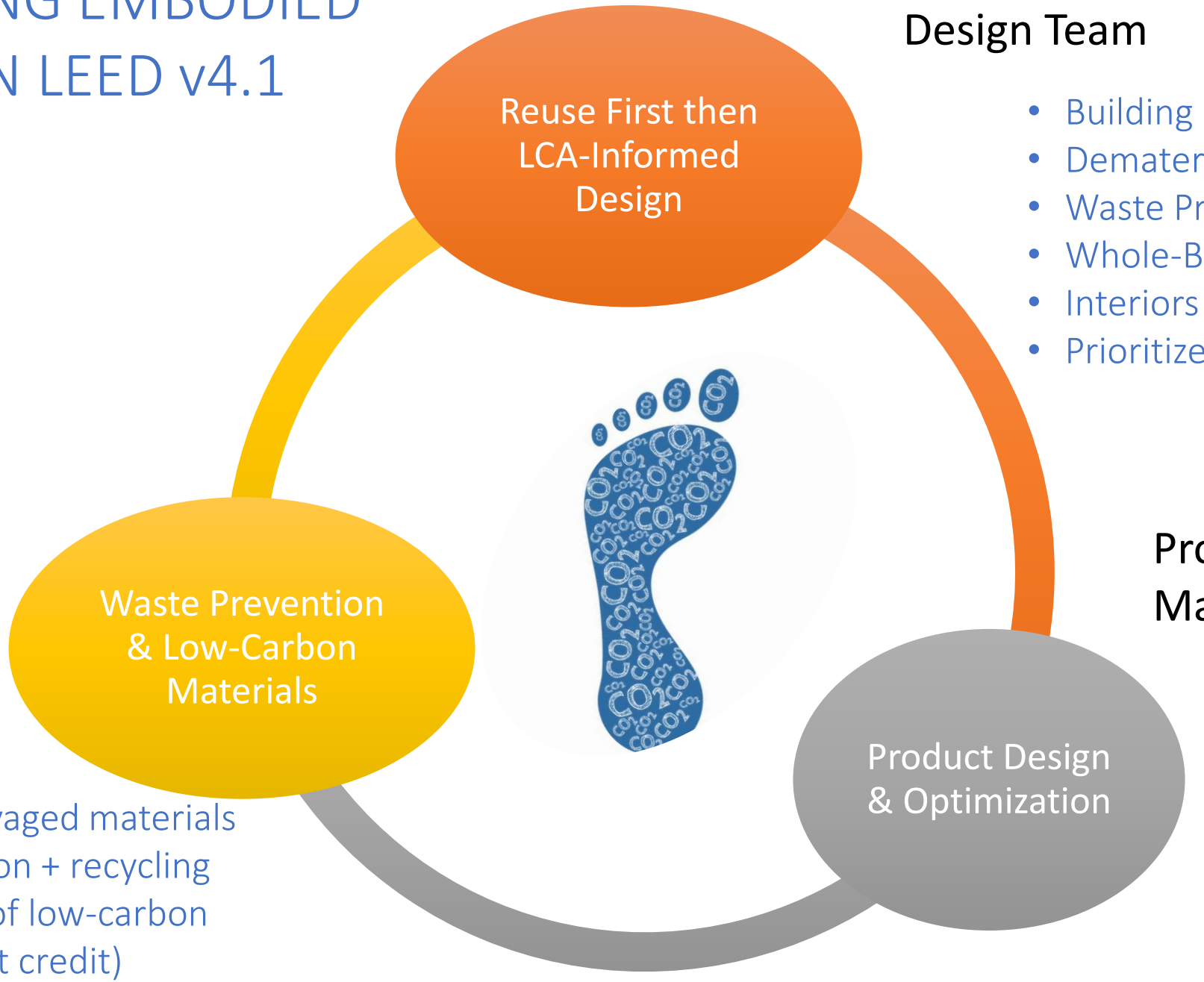
LEED v4
Nov. 2013
Outcome oriented

LEED v4 Introduced concepts of product transparency and life-cycle analysis
- *EPDs*
- *Ingredient disclosure*
- *Whole-Building LCA*

LEED v4.1
2019
Timely Updates

LEED v4.1 refreshed credits to encourage uptake and recognize industry advancements

ADDRESSING EMBODIED CARBON IN LEED v4.1



Design Team

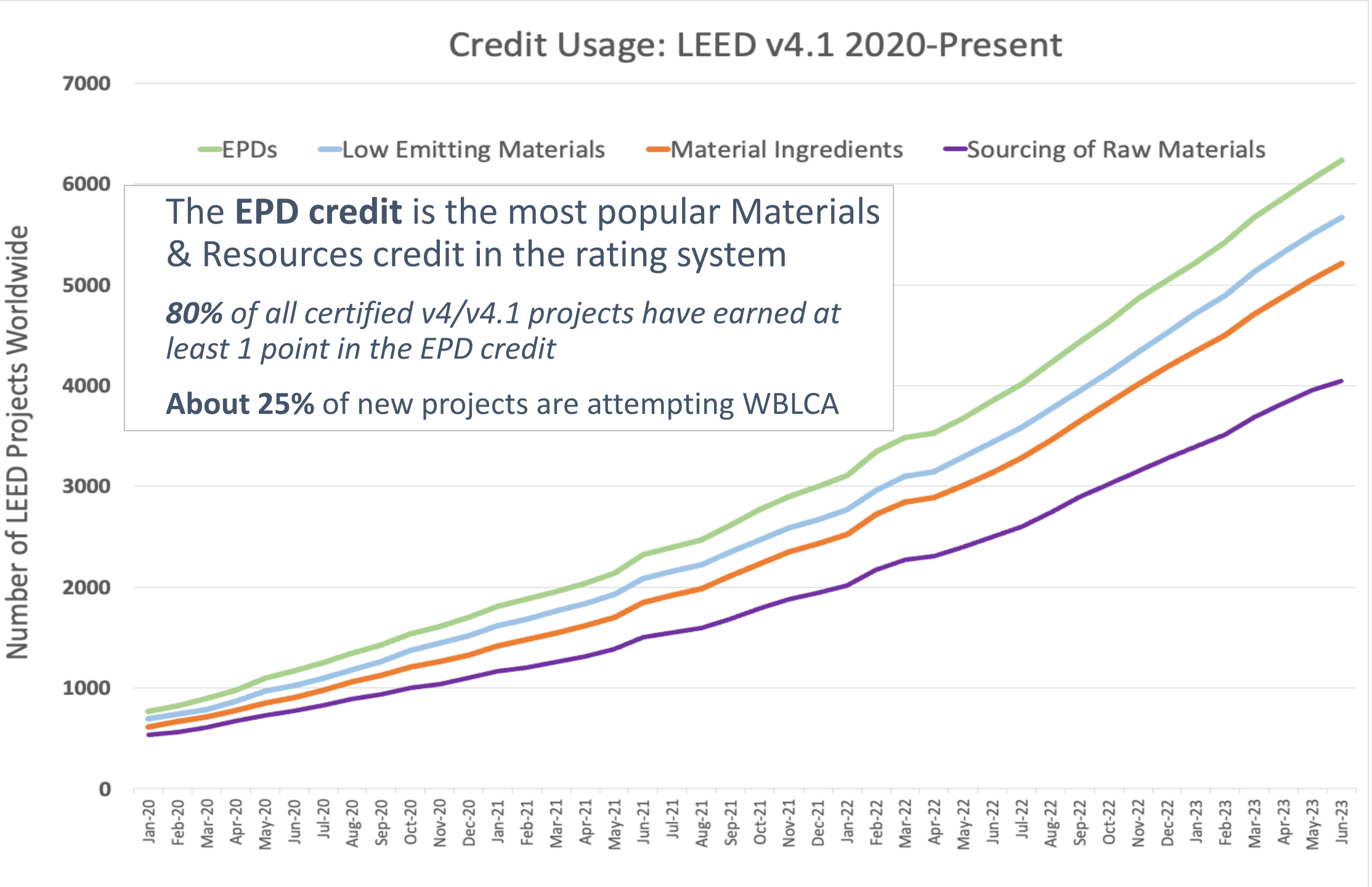
- Building Reuse
- Dematerialization
- Waste Prevention
- Whole-Building LCA
- Interiors LCA
- Prioritize Low-Carbon Materials

Product Manufacturers

- EPDs
- Optimized EPDs
- Biobased materials
- Recycled content

Construction Team

- Reuse and salvaged materials
- Waste reduction + recycling
- Procurement of low-carbon materials (pilot credit)



The **EPD credit** is the most popular Materials & Resources credit in the rating system

80% *of all certified v4/v4.1 projects have earned at least 1 point in the EPD credit*

About 25% of new projects are attempting WBLCA

Procurement of Low-Carbon Construction Materials Pilot Credit

1-2 Points available

Step 1: Develop a building embodied carbon intensity “baseline” calculation

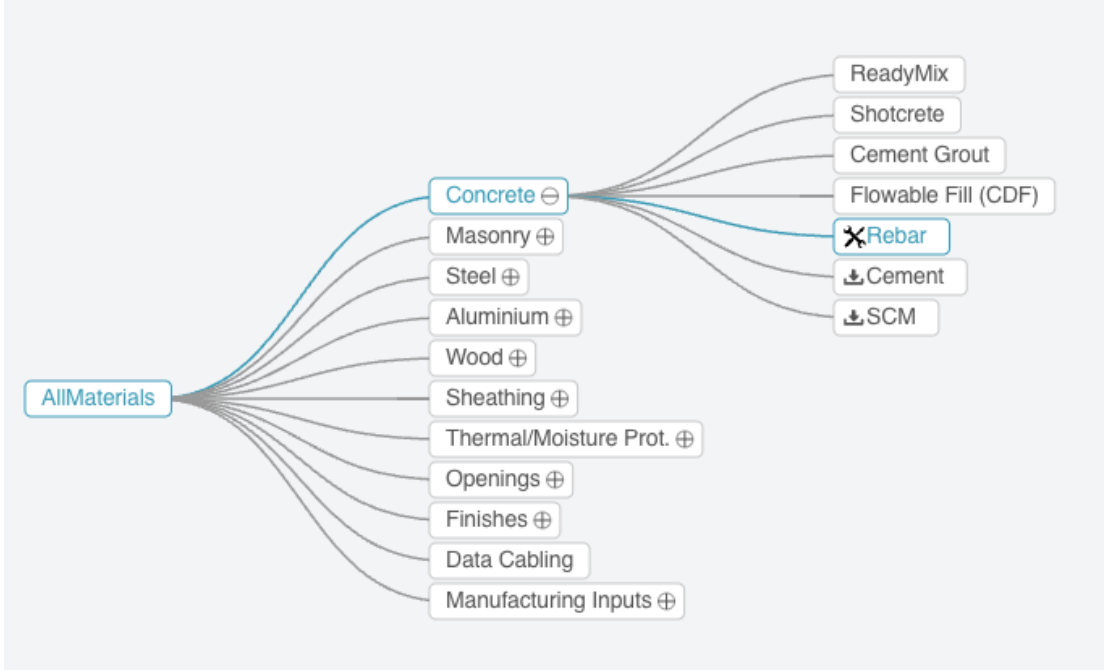
Step 2: Develop a building embodied carbon intensity “verified reduction” calculation

Step 3: Calculate the percent difference between baseline and reduction

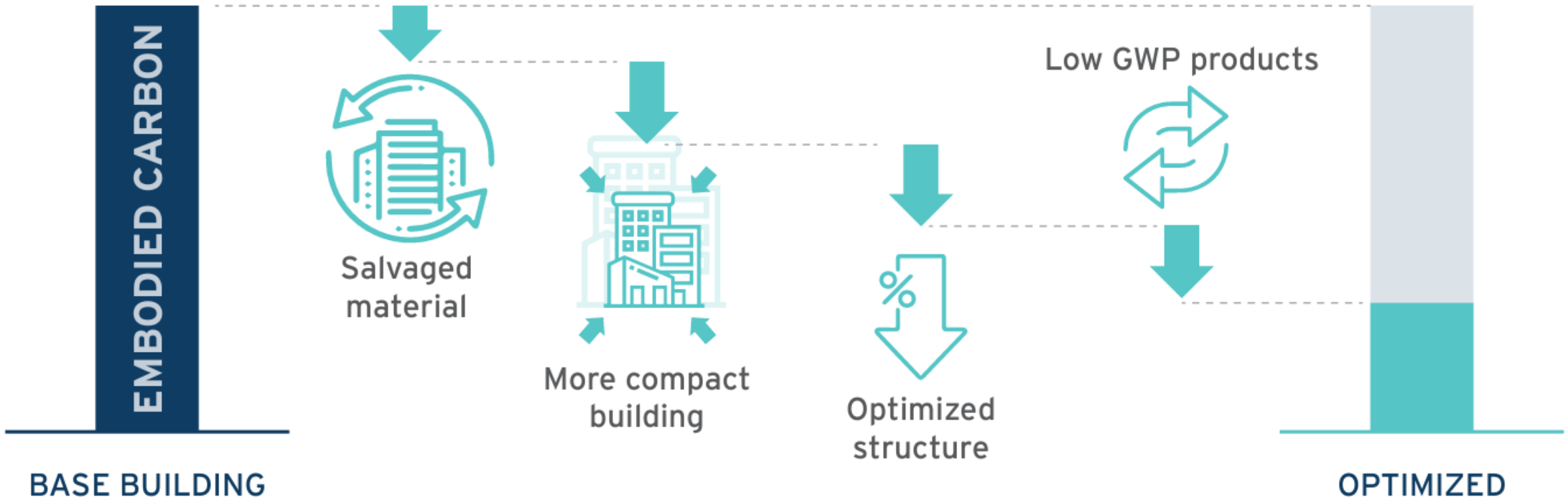
Points are awarded based on the reduction amount:

- Low range reduction (0-30%) - 1 Point
- Mid-range reduction (30+%) - 2 Points

EC3



A COMBINATION OF INTERVENTIONS CAN RESULT IN DEEPER REDUCTIONS THAN PURSUING JUST ONE.



EVOLUTION OF LEED

LEED v1.0-2.2

1998 – 2009
Strategy based

LEED 2009

2009
Analytically weighted

LEED v4

November 2013
Focus on outcomes

LEED v4.1

January 2019
Timely Updates

LEED v5

Drafts released January 2024

Stakeholder input and ballot 2024

THANK YOU

Wes Sullens, LEED Fellow
Director, Materials & Resources
Based in Northern California
wsullens@usgbc.org

U.S. Green Building Council
usgbc.org

Cellulose Insulation Manufacturers Association

NASEO BUILDINGS COMMITTEE:

Low-Embodied Carbon and Energy Efficient Residential Construction Materials

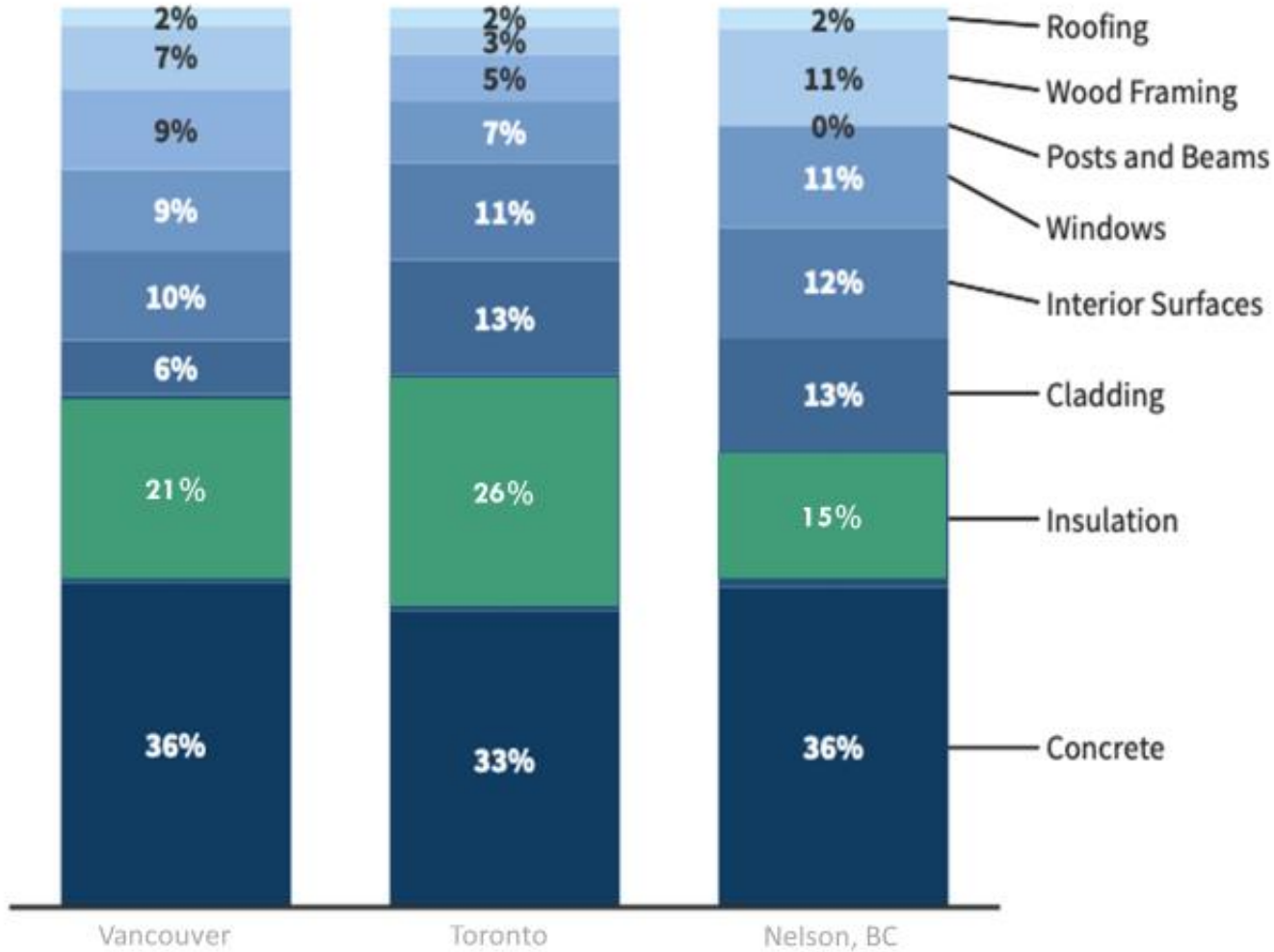
SEPTEMBER 19, 2023

WHAT'S CELLULOSE INSULATION?

1. Composed of recycled paper/cardboard and fire retardants
2. Great for new construction applications and retrofits
3. Lowest EC of all commercially available insulation materials

CIMA

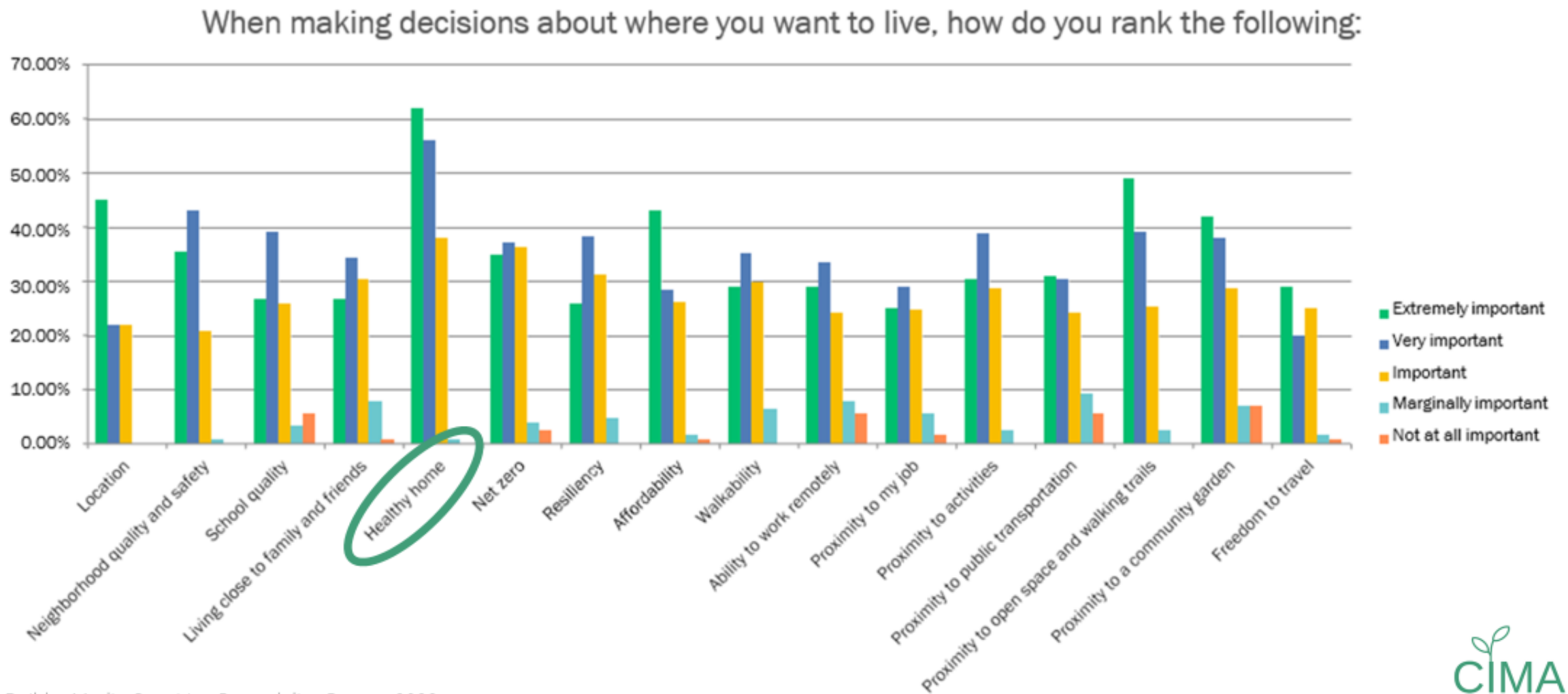
WHY SHOULD WE CARE ABOUT SOMETHING WE CANNOT SEE?



Chris Magwood and Tracy Huynh, *The Hidden Climate Impact of Residential Construction*, RMI, 2023.

CIMA

HEALTHY HOMES ARE LEADING PURCHASE DECISION DRIVERS

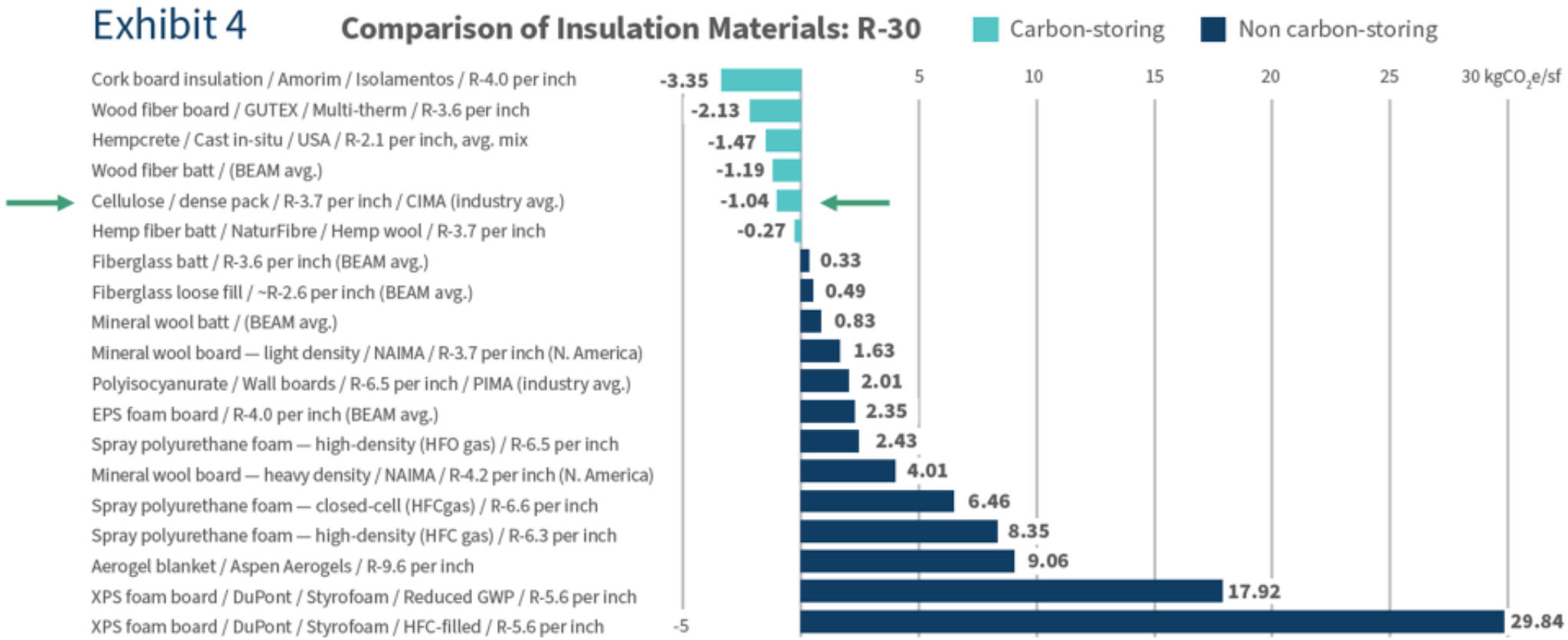


Green Builder Media Cognition Remodeling Report, 2022.

CIMA

SO MANY OPTIONS, SO MUCH VARIANCE

Exhibit 4 Comparison of Insulation Materials: R-30



ix Exhibit 4 demonstrates a broad range of available insulation materials and corresponding GWP as a guide for comparison. As indicated in the product description, data represents either industry averages or product-specific GWP but is not exhaustive for all products available. Individual EPDs for actual specified products should be used in project-specific analysis.

Heather Clark, Chris Magwood, Victor Olgyay, and Eva Rosenbloom, *Transforming Existing Buildings from Climate Liabilities to Climate Assets*, RMI, 2023.

CIMA

BEAM TOOL FOR EMBODIED CARBON REPORTING

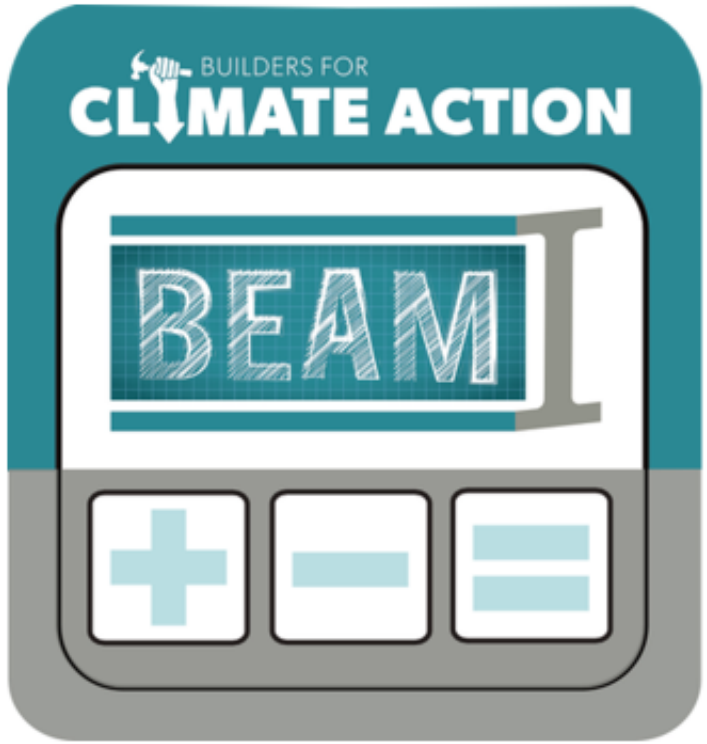
Building Emissions Accounting for Materials

www.buildersforclimateaction.org

BEAM is a free, easy-to-use tool that brings embodied carbon analysis to the residential construction sector.

BEAM is made for users in the low- and mid-rise sector and is intended to be used by people with no background in LCA, but who understand materials and assemblies.

Users can quickly model the carbon footprint of buildings and products to gain clear insights for making informed, climate-smart choices.



CIMA

BEAM METHODOLOGY

Building Emissions Accounting for Materials

www.buildersforclimateaction.org

A1-A3 GWP factors from EPDs

A1-A3 biogenic carbon storage minus 10%
(not including virgin timber)

Material quantity, based on dimensions

Net emissions kg CO_2e

Phyllis2

FOUNDATION WALL AREA	74.3	m²
FOUNDATION SLAB AREA	55.7	m²
EXTERIOR WALL AREA	100.0	m²
WINDOW AREA	18.7	m²

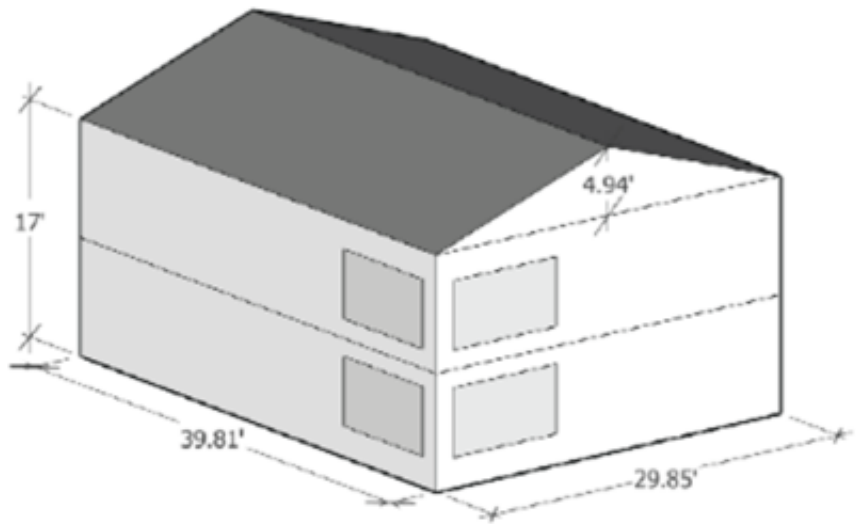
8,292
NET EMISSIONS (kg CO_2e)

CIMA

EMBODIED CARBON IN A HOME

US DOE Model Slab-on-grade

Two stories above grade, 2x6 framed wall



Roof insulation area : **1188 ft²**

Exterior wall insulation area : **2021 ft²**

*Excludes window area

Total floor area : **2377 ft²**

The DOE Model Home is used to explore the emissions for a range of common insulation materials to make this comparison.

Assumes a slab-on-grade foundation with 30x40’ exterior dimensions on two levels, each 8.5’ tall and including one standard size window per floor per each building aspect.

Megan Nedzinski, Mélanie Trottier and Chris Magwood, *The Carbon Story of Cellulose Insulation*, Builders for Climate Action, 2023.

CIMA

...LET'S COMPARE VIA BEAM

Insulation comparison for DOE model home

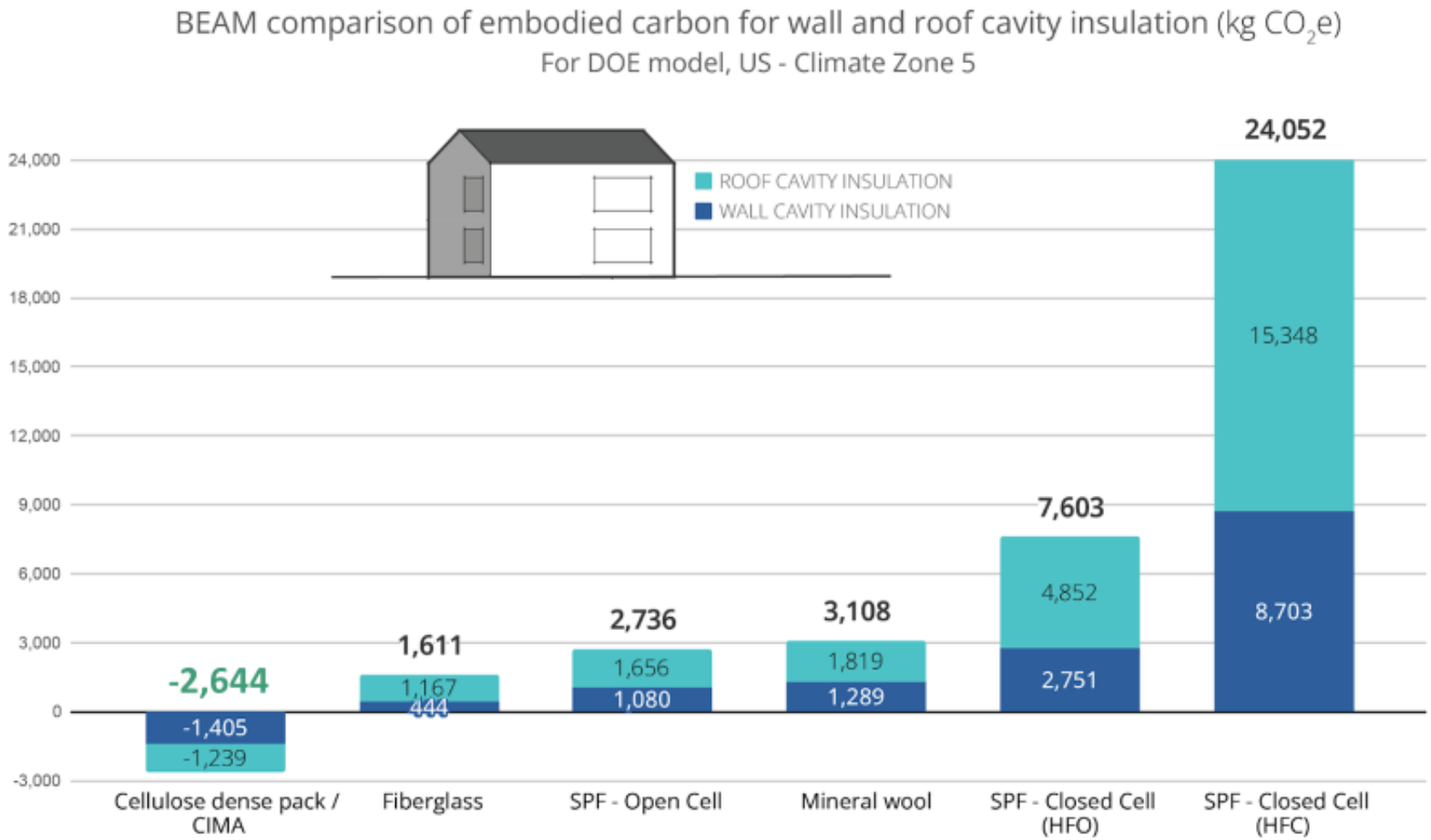
	MATERIAL	R / inch	US - Zone 3 NET EMISSIONS (kg CO_2e)	US - Zone 3 R-Value Input	US - Zone 5 NET EMISSIONS (kg CO_2e)	US - Zone 5 R-Value Input	CANADA - Zone 7 NET EMISSIONS (kg CO_2e)	CANADA - Zone 7 R-Value Input
WALL CAVITY INSULATION	Cellulose dense pack - CIMA Emmisions / Storage	3.7	**-1,405** 644 / -2,050	20	Same as **US-Zone 3**		Same as **US-Zone 3**	
	Fiberglass batt [BEAM Avg]	3.6	**444**	20				
	Spray polyurethane foam - Open Cell	4.1	**1,080**	23*				
	Mineral wool batt [BEAM Avg]	4.2	**1,289**	23*				
	Spray polyurethane foam - Closed Cell (HFO gas)	6.6	**2,751**	20				
	Spray polyurethane foam - Closed Cell (HFC gas)	6.6	**8,703**	20				
ROOF CAVITY INSULATION	Cellulose loose fill - CIMA Emmisions / Storage	3.7	**-1,012** 464 / -1,476	49	**-1,239** 568 / -1,807	60	**-1,239** 568 / -1,807	60
	Fiberglass loose fill [BEAM Avg]	2.6	**953**	49	**1,167**	60	**1,167**	60
	Spray polyurethane foam - Open Cell	4.1	**1,352**	49	**1,656**	60	**1,656**	60
	Mineral wool loose fill - NAIMA	3	**1,486**	49	**1,819**	60	**1,819**	60
	Spray polyurethane foam - Closed Cell (HFO gas)	6.6	**3,962**	49	**4,852**	60	**4,852**	60
	Spray polyurethane foam - Closed Cell (HFC gas)	6.6	**12,534**	49	**15,348**	60	**15,348**	60

*For a 2x6 framed wall cavity

Megan Nedzinski, Mélanie Trottier and Chris Magwood, *The Carbon Story of Cellulose Insulation*, Builders for Climate Action, 2023.

CIMA

...SPECIFICALLY FOR CLIMATE ZONE 5



Megan Nedzinski, Mélanie Trottier and Chris Magwood, *The Carbon Story of Cellulose Insulation*, Builders for Climate Action, 2023.

CIMA

INDUSTRY-WIDE EPD FOR BUILDING ENVELOPE THERMAL INSULATION

1. Extension required for original PCR (Part B)
2. Committee for PCR comments – advocacy for carbon storage
3. Hire an LCA practitioner to collect lots of data ("Data from the third party shall be aggregated with no trace to the original source of data.") and a Program Operator to make the EPD.
4. Share it far and wide with the building community

CIMA

Cellulose Insulation Manufacturers Association

Rachel Stern

EXECUTIVE DIRECTOR

rachel@cellulose.org
www.cellulose.org

SPECIAL THANKS TO OUR FRIENDS!

BUILDERS FOR CLIMATE ACTION

CLF Carbon Leadership Forum

RMI ENERGY TRANSFORMED

The Vinyl Siding Institute is the trade association for manufacturers of vinyl and other polymeric siding and suppliers to the industry - As industry advocates, it's our goal to further the development and growth of the vinyl and polymeric siding industry by helping to develop material, product, and performance standards in cooperation with standards-making organizations and code bodies.

--

Matt Dobson has been involved with the housing industry for over 25 years and sustainability for close to 15.

Dobson graduated from Michigan State University with a Bachelor of Science degree in Building Construction Management.

In his current role as Vice President for the Vinyl Siding Institute, Dobson has general oversight of the advocacy efforts of the organization and leads VSI's Sustainability Committee. His focus also includes representing the industry on national building code, research, design, sustainability, and energy issues.

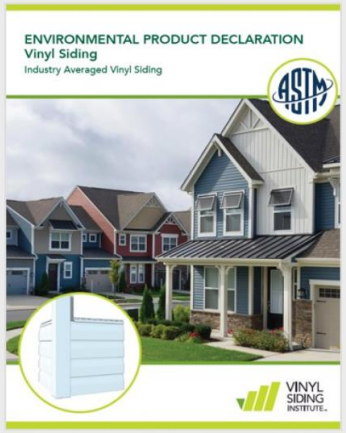
Matt Dobson
Vice President
MDobson@vinylsiding.org
www.vinylsiding.org

VINYL SIDING INSTITUTE™

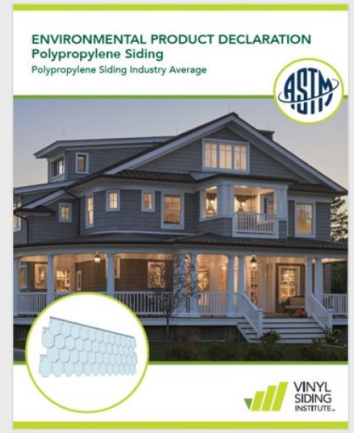
Sustainability

VSI is 100% committed to sustainability using the science of life cycle assessment through the publication of third-party ASTM Certified Environmental Product Declarations

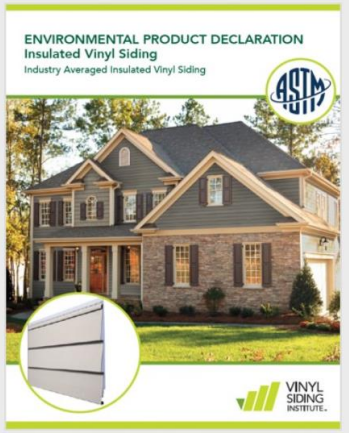
- In 2010 VSI working with UL Environment and other cladding interests created product category rules for environmental product declaration development
- Vinyl siding manufacturers are making steady and conscious progress at every step to lessen this material's carbon footprint
- Our carbon emissions have decreased 15% over the life cycle of vinyl siding in the past decade
- That's 9.8 kg of CO_2 per 100 square feet materials
- Lightweight products are critical to continuous insulation applications and compliance with the ICC



Vinyl Siding

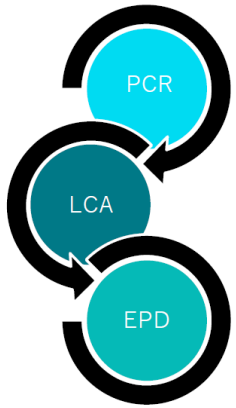


Polypropylene Siding



Insulated Vinyl Siding

Components behind an EPD



Product Category Rules (PCRs)
Set of rules, requirements and guidelines for conducting LCAs and developing EPDs for one or more product categories.

Life Cycle Assessment (LCA)
Method to assess environmental impacts of all stages of a product's life; from-cradle-to-grave

Environmental Product Declaration (EPD) –
Essentially a condensed version of the LCA, with information reported according to the PCR.
3rd party verified, internationally recognized, Type III Ecolabel and comprehensive disclosure of a product's environmental impact throughout its life cycle.

IECC®
INTERNATIONAL
ENERGY CONSERVATION
CODE®

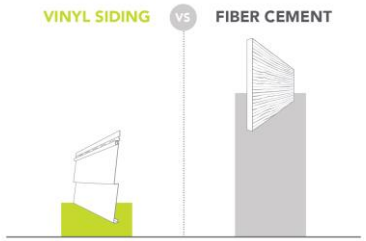
Environmental Impact & Measuring Carbon Footprint

The industry's environmental impact reductions since 2011 include[1]:

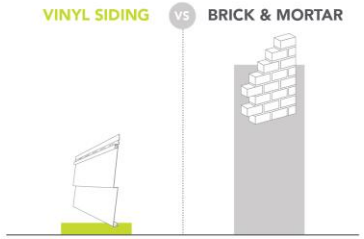
22% less electricity

33% less natural gas

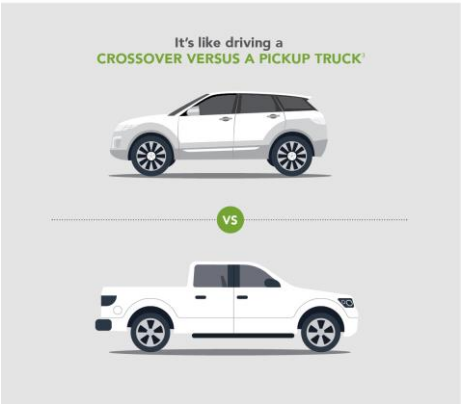
100% less propane

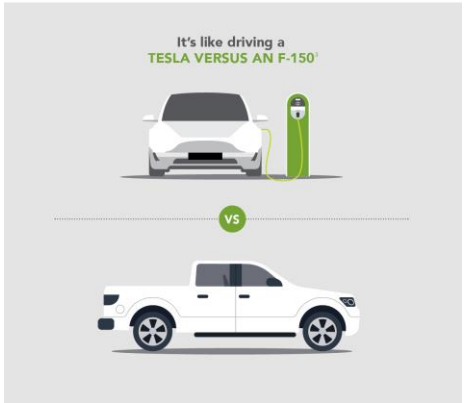


The impact of vinyl siding on global warming is **40%** LESS IMPACT THAN FIBER CEMENT[2]



The impact of vinyl siding on global warming is **83%** LESS IMPACT THAN BRICK & MORTAR[2]





INSULATED VINYL SIDING

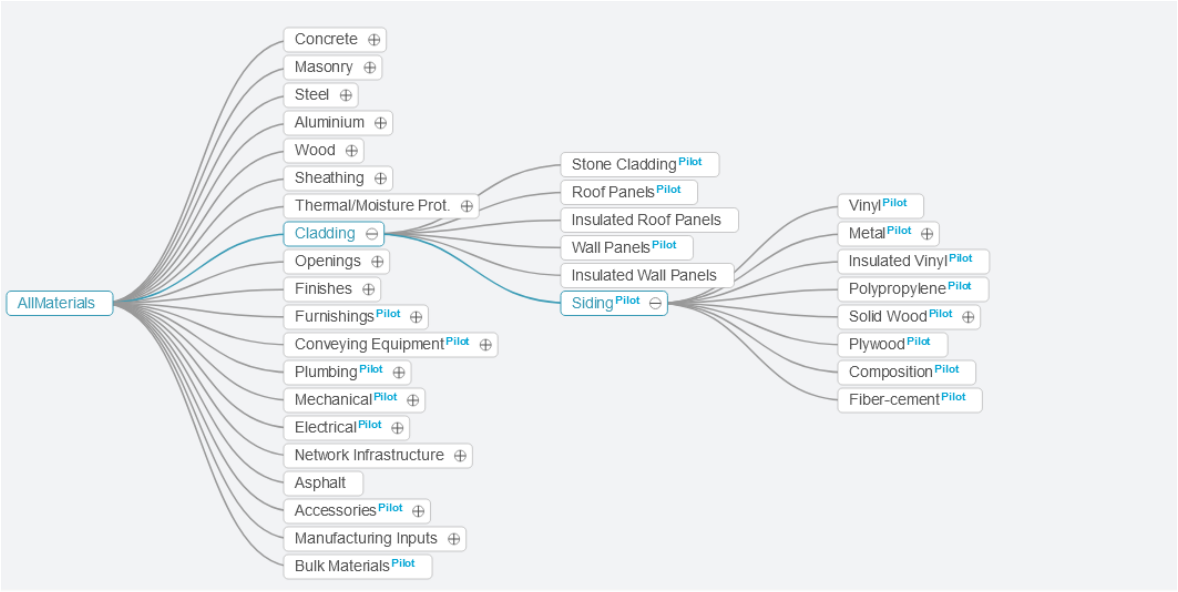
Carbon Footprint

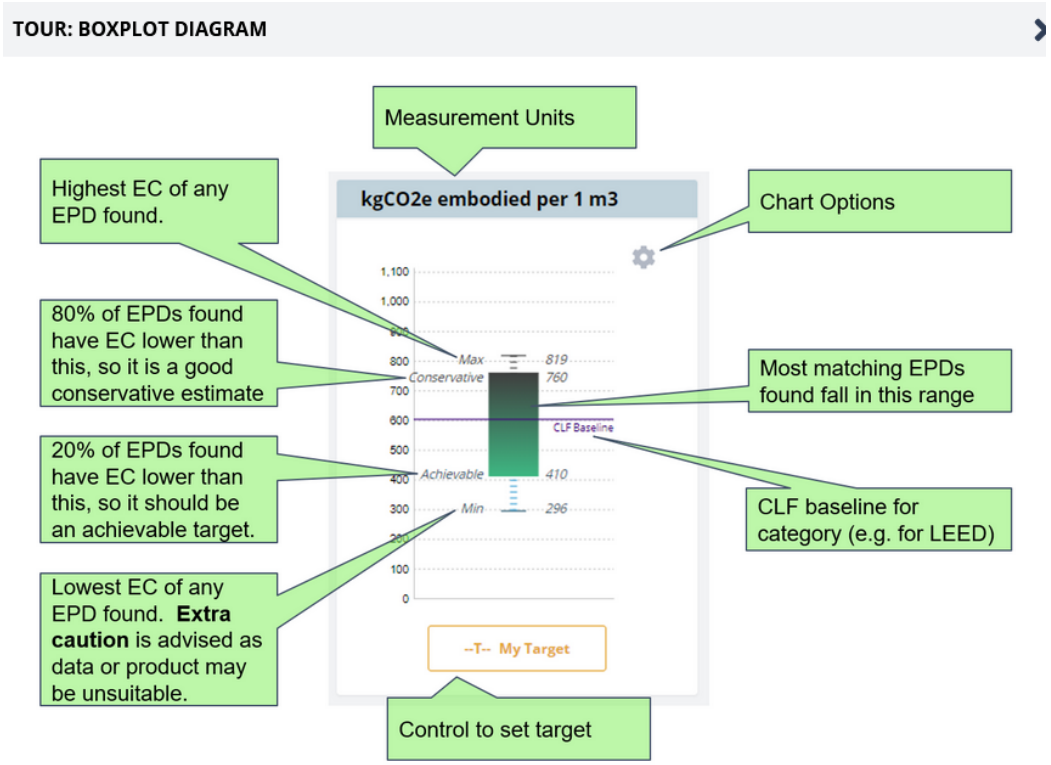
To understand the measurement of the numbers below check out the BEES (Building for Environmental and Economic Sustainability software) tool online. A tool developed by the NIST (National Institute of Standards and Technology) that measures the life cycles of different types of cladding.

Insulated vinyl siding manufacturing is an extremely efficient process that require few raw materials. There are relatively low inputs of energy during the extraction, transport and manufacturing process.	6.05 kg CO2 Eq.
The transport of insulated vinyl siding from packaging to construction takes little energy because it weighs less than other typical construction building materials.	0.21 kg CO2 Eq.
The installation of siding is done primarily by manual labor. Nails or screws can be used to install the siding. The energy required to operate compressors to power air guns is quite small.	0.55 kg CO2 Eq.
No routine maintenance is required to prolong the lifetime of insulated vinyl siding, although cleaning is recommended to maintain appearance. Cleaning would normally be done with water and household cleaners.	0.14 kg CO2 Eq.
Replacement is not common. As the lifetime of a building is assumed to be 75 years, a replacement factor of 0.5 is assumed.	3.9 kg CO2 Eq.
The transport of insulated vinyl siding from demolition to waste processing takes little energy because vinyl siding weighs less than other typical construction building materials.	0.02 kg CO2 Eq.
Waste processing of vinyl is limited. Recycling opportunities for insulated vinyl siding are available; there are pilot programs in operation to improve the recycling infrastructure.	0.00 kg CO2 Eq.
Insulated vinyl siding is most commonly disposed of in municipal solid waste streams at the end of the product's service life. This study assumes that 20% of the products get incinerated in waste-to-heat energy recovery facilities and the remaining 80% are landfilled.	1.02 kg CO2 Eq.

Building Transparency: Key to Measuring Embodied Carbon

- EC3 is a free and easy-to-use tool that allows benchmarking, assessment and reductions in embodied carbon, focused on the upfront supply chain emissions of construction materials
- EC3 tool also allows owners, green building certification programs and policymakers to assess supply chain data in order to create EPD requirements, and set embodied carbon limits and reductions, at the construction material and project scale





MICROSOFT GOOGLE LINKEDIN
AMAZON AUTODESK RIB
PROCORE