

In-Person Workshop

Life Cycle Assessments

 Calgary, Alberta

 April 30 | 1 – 4 PM

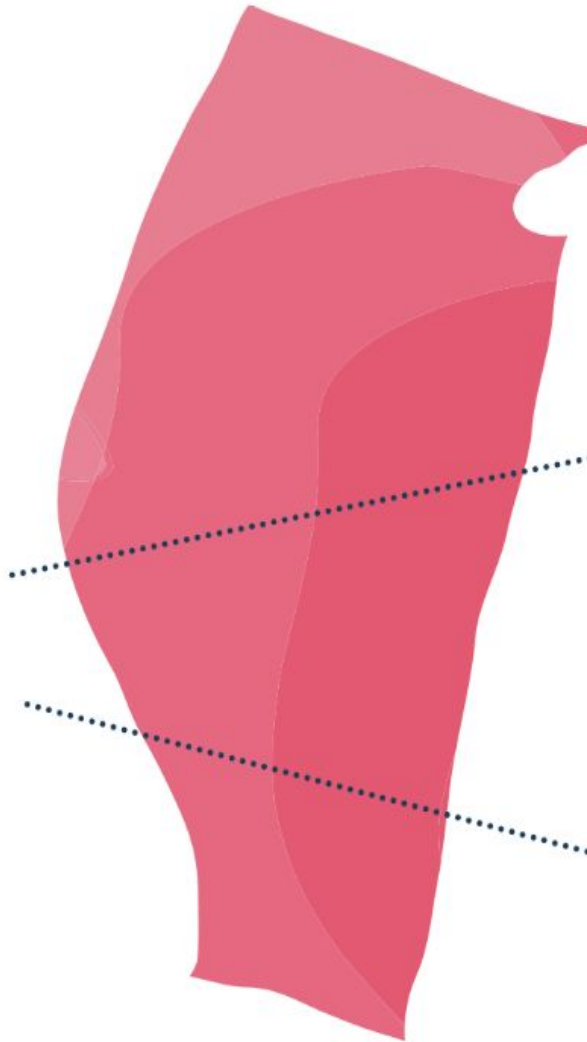
enbix   ALBERTA ecotrust

TREATY 8

Signed in 1899

TREATY 7

Signed in 1877



TREATY 6

Signed in 1876

Alberta Ecotrust Foundation

Vision and Mission

→ *Our Vision*

An Alberta where people and nature thrive.

→ *Our Mission*

We realize our vision by recognizing gaps, mobilizing resources, investing in our communities, creating partnerships, and building capacity across sectors.

What we offer

*Programs
& Initiatives*



Grants



*Impact
Investing*



*Strategic
Engagement*



Alberta Ecotrust's Buildings Initiatives

A dark blue line connects the main logo to the sub-entities below. It starts as a vertical line from the bottom of the logo, goes down, then turns right into a horizontal line, and finally turns down again at the right end.

enbix

Retrofit
accelerator



enbix   ALBERTA ecotrust

Shaping the Exchange

Establishing a platform for the exchange of knowledge around emissions neutral buildings in Edmonton, Calgary and Alberta

Developed by Alberta Ecotrust Foundation in partnership with:
The Calgary Construction Association, the City of Calgary, the City of Edmonton and their Emission Neutral Buildings Industry Advisory Group, and the Smart Sustainable Resilient Infrastructure Association.

November 2023

Our Funders



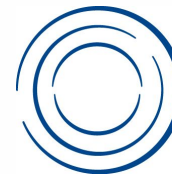
Natural Resources
Canada

Ressources naturelles
Canada



FEDERATION
OF CANADIAN
MUNICIPALITIES

FÉDÉRATION
CANADIENNE DES
MUNICIPALITÉS



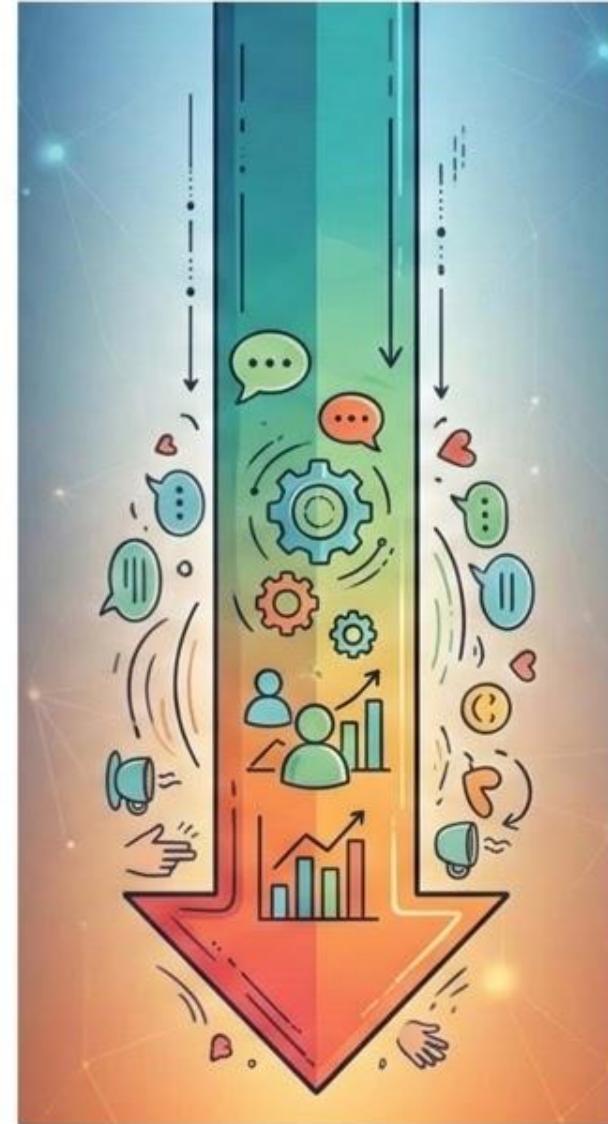
Peter Gilgan
Foundation



RBC Foundation

Agenda

1. Overview of Embodied Carbon
2. Understanding Life Cycle Assessment (LCA)
3. Environmental Product Declarations
4. Practical Integration and Strategies
5. BEAM demonstration
6. Q+A





Embodied Carbon Overview

Defining Embodied Carbon

Embodied carbon:

The greenhouse gas (GHG) emissions generated from the manufacture, transport, installation, maintenance, and disposal/recovery of construction materials



Whole life carbon

Embodied carbon

Product stage			Construction stage		In-use stage					End of life stage			
A1	A2	A3	A4	A5	B1	B2	B3	B4	B5	C1	C2	C3	C4
Raw material supply	Transport	Manufacturing	Transport	Construction & installation process	Use	Maintenance	Repair	Refurbishment	Replacement	Deconstruction & demolition	Transport	Waste processing	Disposal

Operational carbon

B6	Operational energy
B7	Operational water

Circular economy

Beyond building life cycle

D

Benefits & Loads

Reuse
Recovery
Recycling

Cradle to gate

Cradle to practical completion

Cradle to grave

Cradle to cradle

Life cycle stages (adapted from LETI Embodied Carbon Primer, <https://www.leti.london/ecp>)



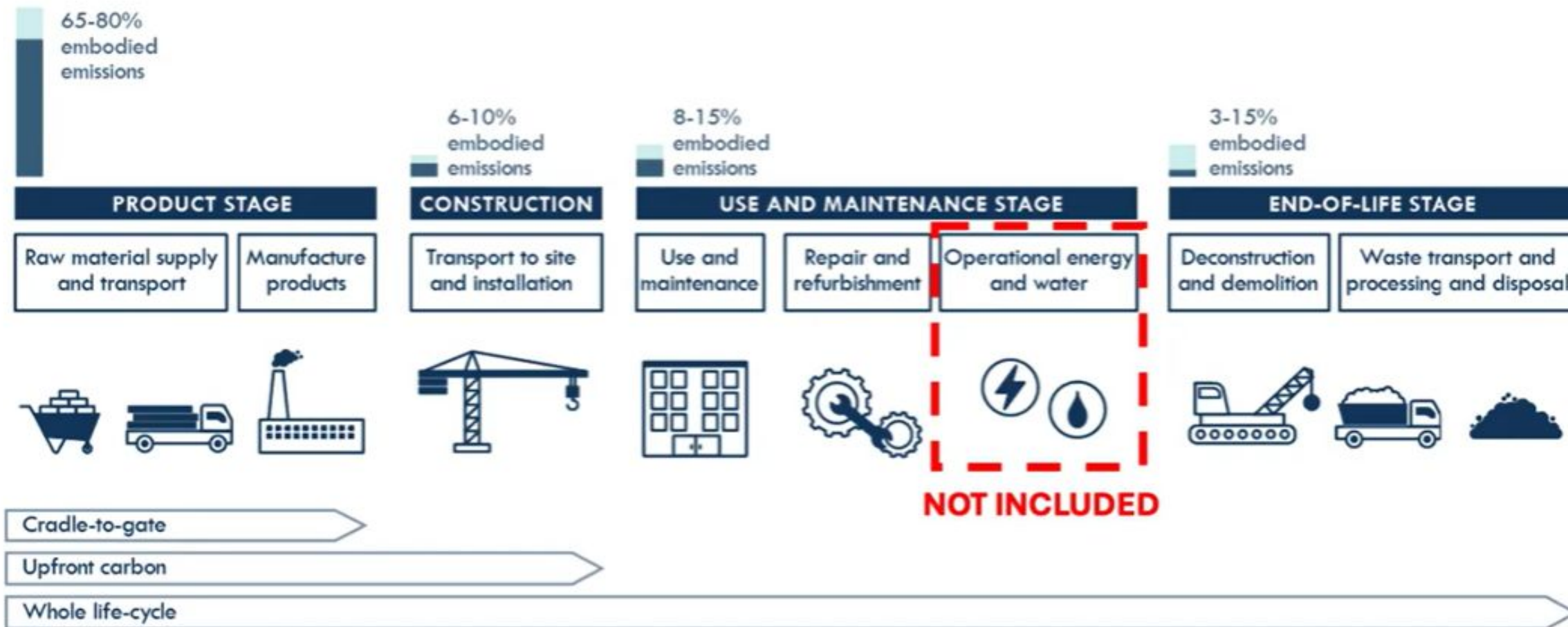


Image from Builders for Climate Action



How do you measure embodied carbon

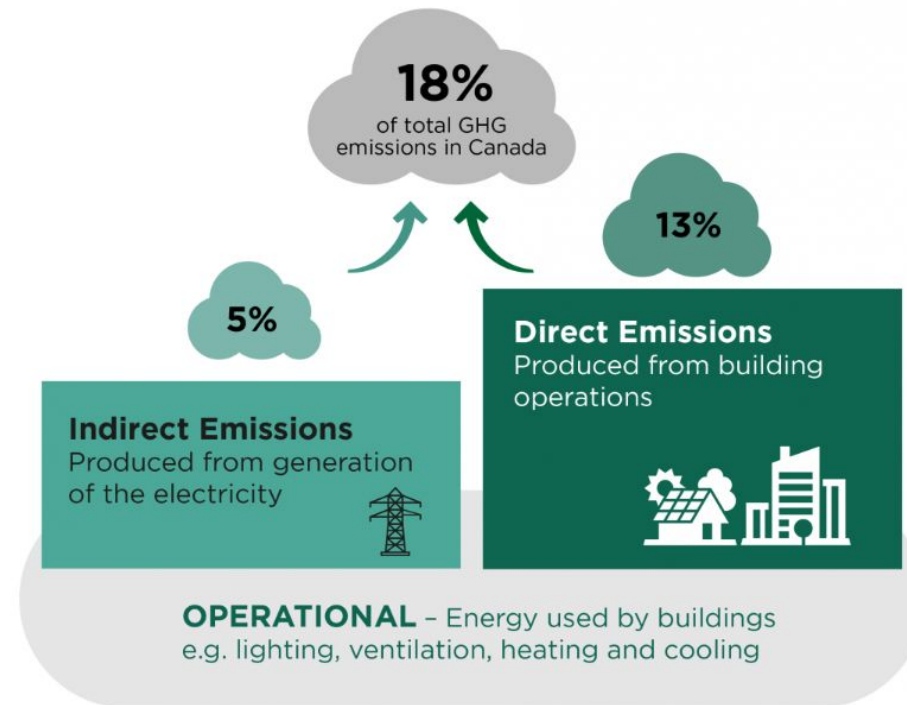
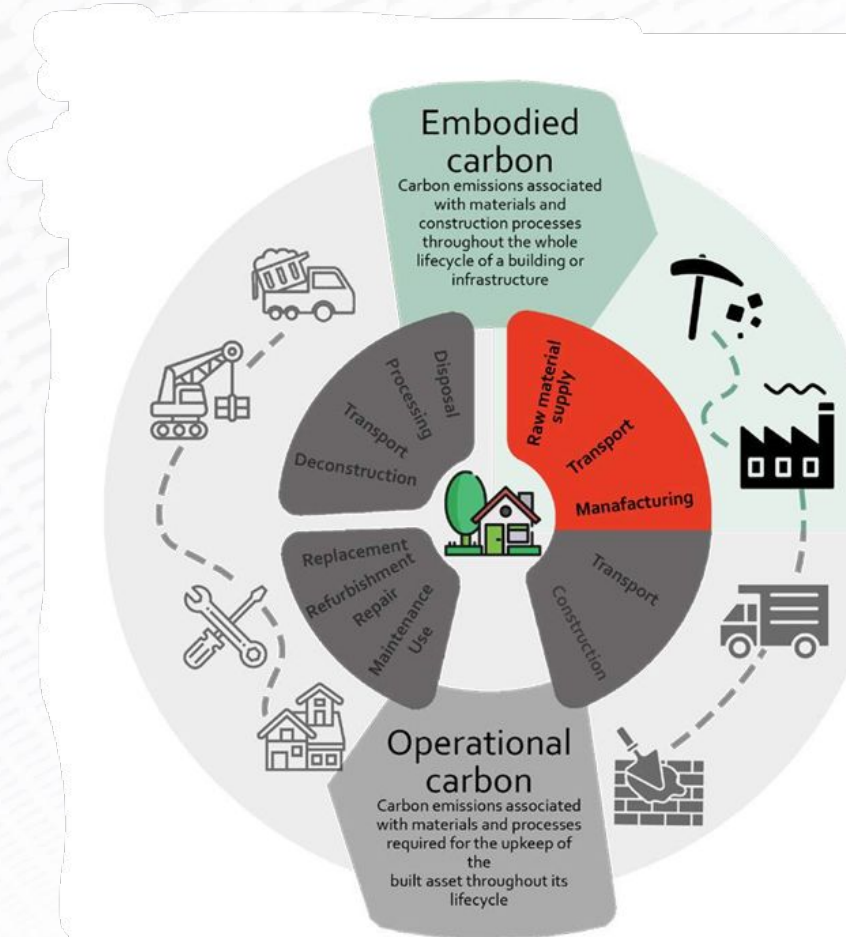


Image from CLF



Why are these emissions important?

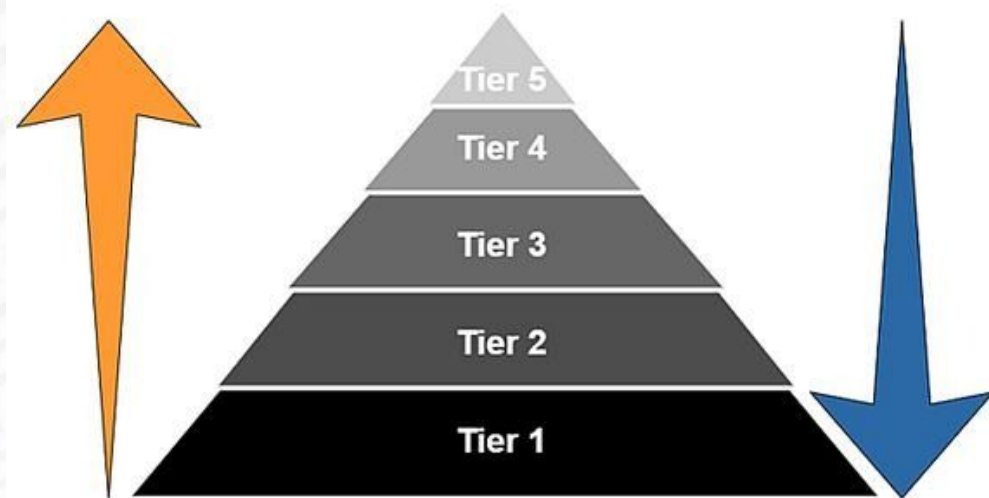
Operational and Embodied Carbon Emissions



images from NRCAN



Carbon Impacts of the Energy Code for Canadian Housing



■ Operational carbon
■ Embodied carbon

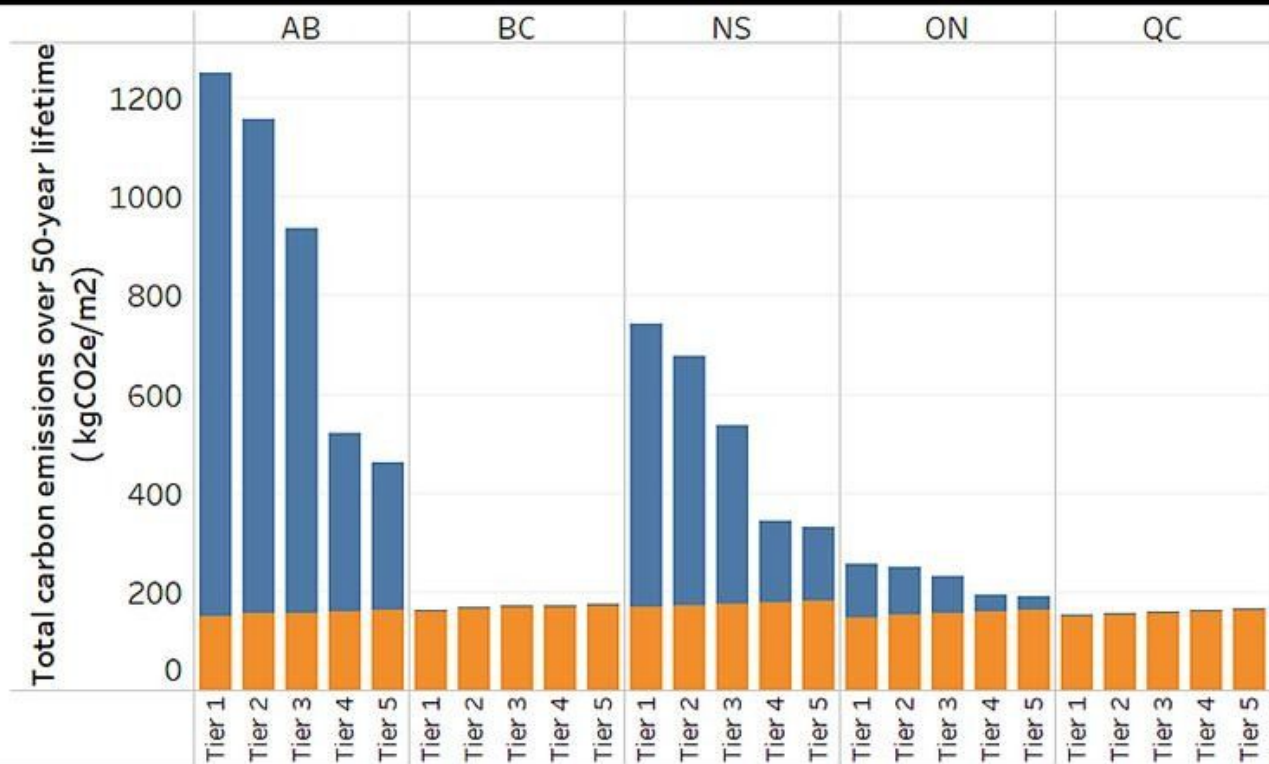


Figure 1: Vancouver High Performance Building
(Cumulative Tonnes CO₂e)

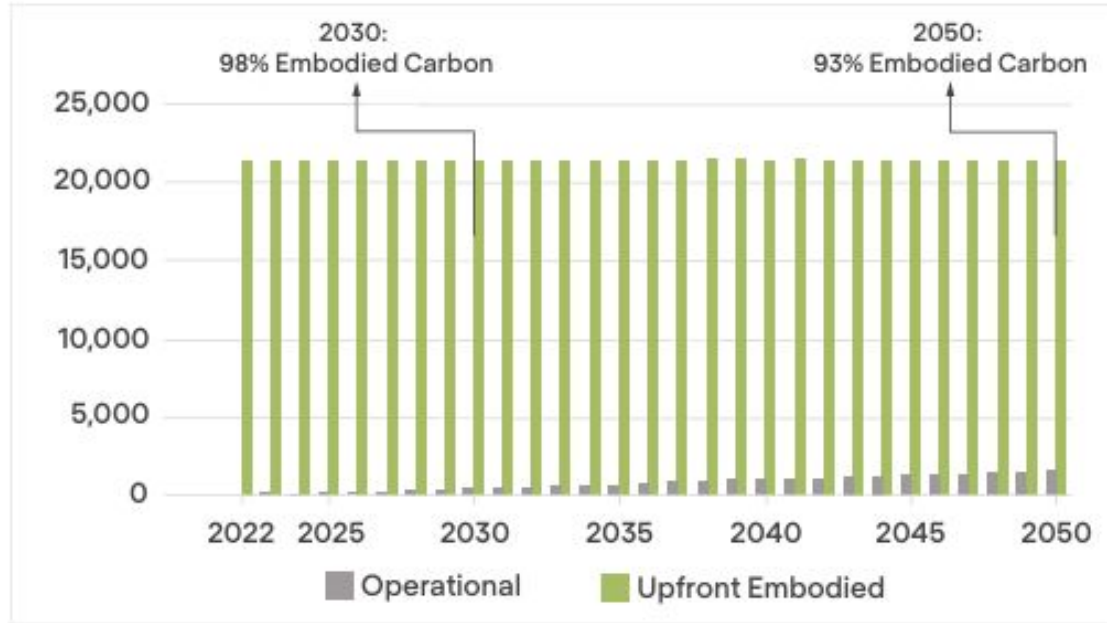
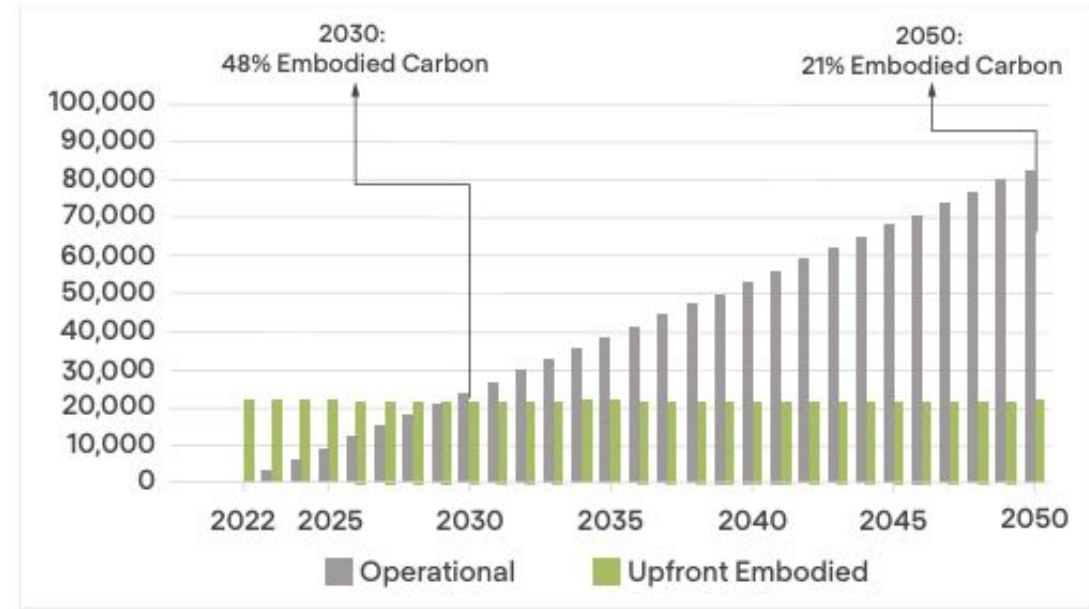


Figure 3: Calgary High Performance Building
(Cumulative Tonnes CO₂e)



What is happening in this space in Canada?

Emissions of Materials Benchmark Assessment *for Residential Construction*



BUILDERS FOR
CLIMATE ACTION



PASSIVE BUILDINGS
CANADA



PATHWAYS TO EMBODIED CARBON REGULATION IN CANADA'S BUILDING CODES

A FRAMEWORK FOR
REDUCING EMBODIED
GREENHOUSE GAS
EMISSIONS IN PART 9
CONSTRUCTION

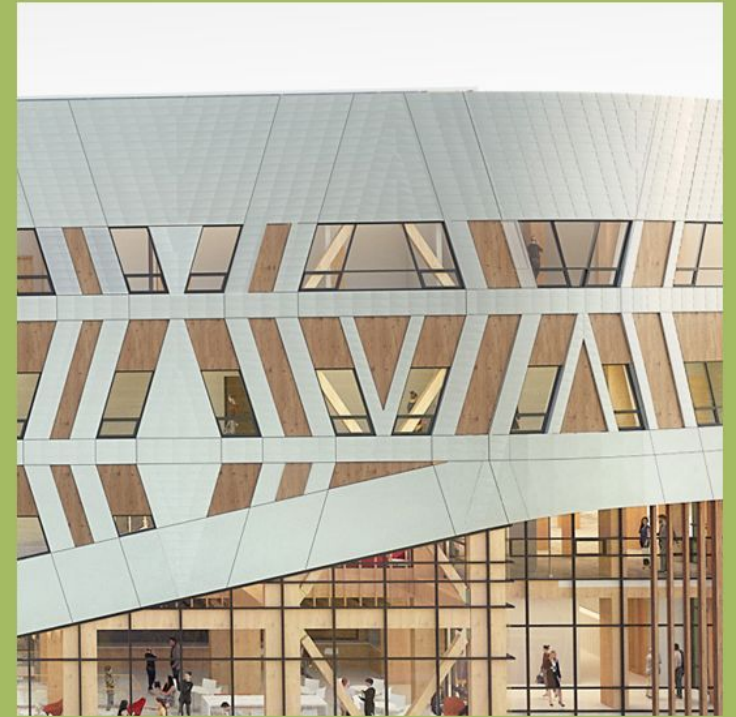
BUILDERS FOR
CLIMATE ACTION



Natural Resources
Canada

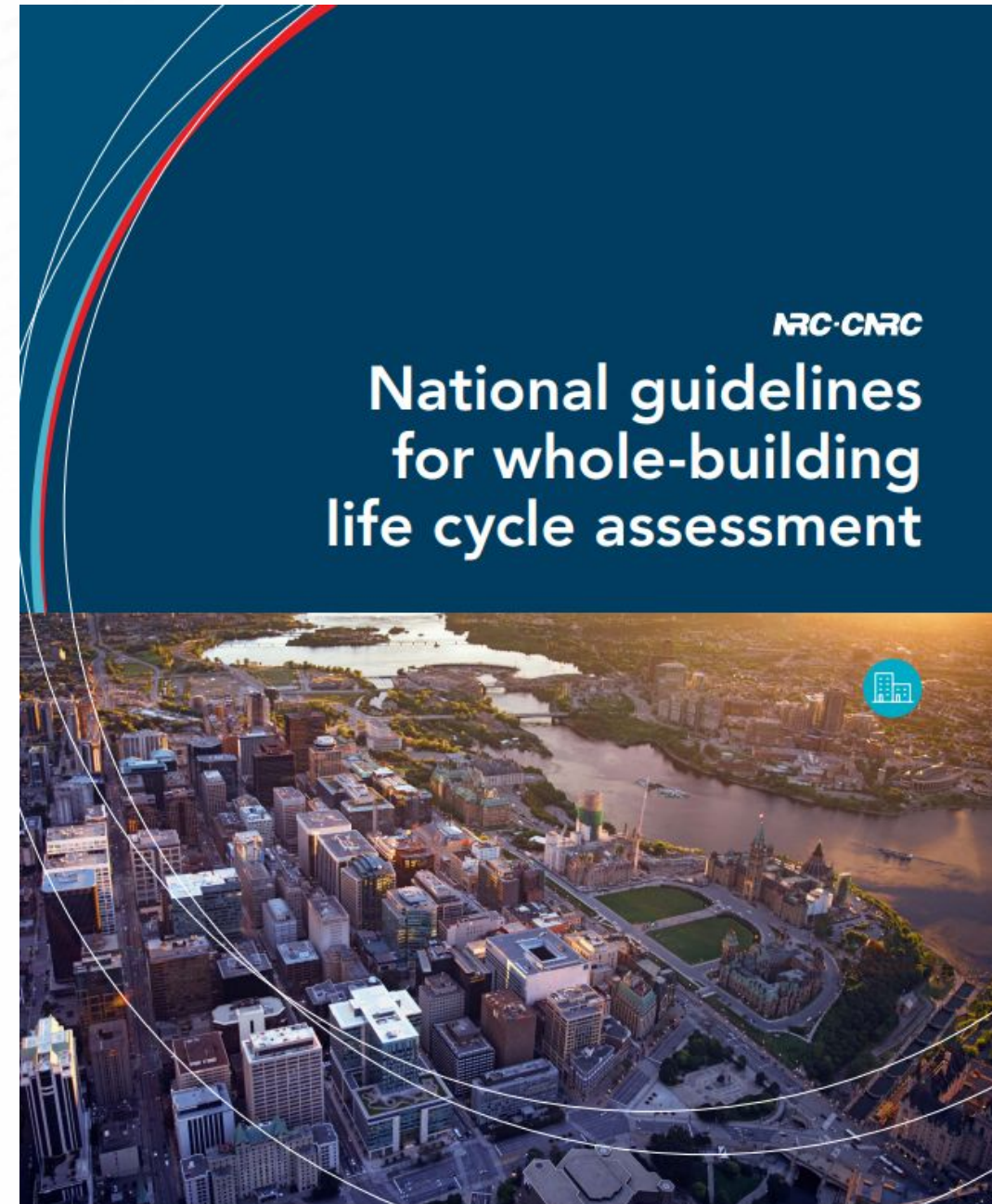
White Paper

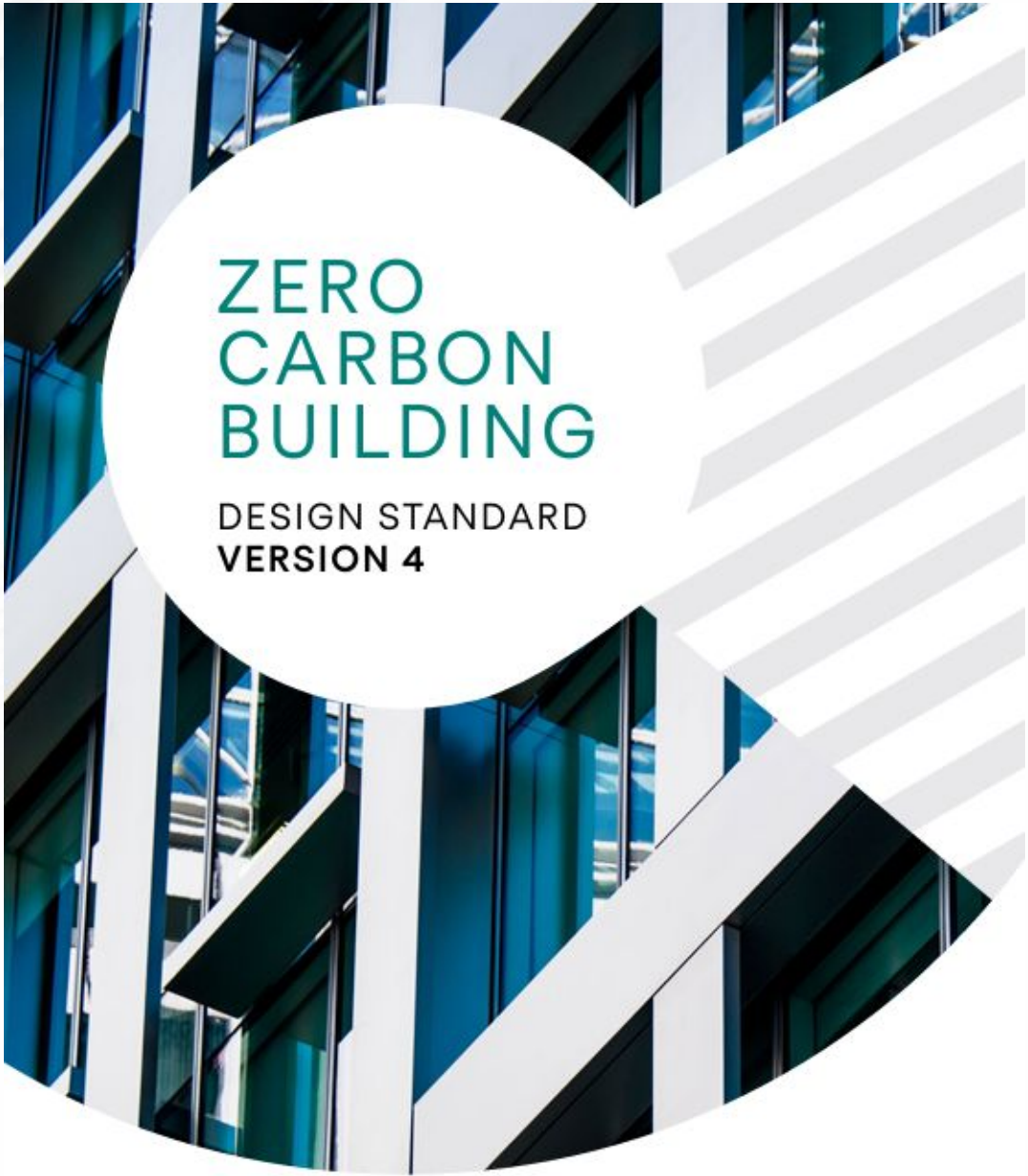
Embodied Carbon: A Primer for Buildings in Canada



National Whole-Building Life Cycle Assessment Practitioner's Guide

Guidance for Compliance Reporting of Embodied Carbon in Canadian Building Construction





ZERO CARBON BUILDING

DESIGN STANDARD
VERSION 4



Climate Smart Buildings Alliance

LEADING CANADA'S TRANSITION TO A NET ZERO
BUILDINGS SECTOR



Total Number of
Pact Signatories
and Supporters

 37

Total Companies
Submitting
Reports

 25

Total Number
of Pilot Projects
Reported

 109

Percentage of
Total Low Carbon
Concrete Usage



40% of projects replaced
11-31% of concrete
with low carbon options

33% of projects replaced
60-90% of concrete
with low carbon options

27% of projects replaced
91+% of concrete
with low carbon options

Based on the limited reporting sample, some projects where concrete primarily serves as the foundation were able to displace a high percentage of total concrete—for instance, stick built housing. Larger projects also appeared to achieve higher percentages of low carbon concrete, likely due to savings from bulk purchasing.

Biggest Challenges That Affect Low
Carbon Concrete Usage



Contractors:
Cost, Performance,
Weather



Developers:
Cost,
Other Factors



Consultants:
Cost, Scheduling,
Weather

Percentage of Signatories' Workers Learning
About Low Carbon Materials



Low carbon material education is most widespread among consultants, which makes sense given their advisory and design roles. However, developers and contractors are also rolling out full staff training on low carbon building strategies.

Material Cost Increase from
Using Low Carbon Concrete

Pie chart shows # of companies



Note: There appears to be a correlation between larger projects and smaller price increases, likely due to bulk purchasing.

Biggest Use Areas for Low
Carbon Concrete

- Foundations
- Slabs on Grade
- Slabs on Deck
- Below Grade Structural Components
- Shear Walls
- Footings
- Walls
- Columns
- Suspended Slabs and Beams
- Parking Ramp
- Topping Concrete

Total Reported GHG
Emissions Reported:

Almost **60,800** Tonnes
(Equivalent to the emissions of 13,200 cars)



Getting to Zero Research Project

Turning real-world data into practical building insights

Stream 2: Embodied emissions

This stream collects data in the design and construction phase of new Part 9 residential projects that use low-carbon materials.

It aims to survey Alberta's current practices in construction-related embodied carbon, which are the emissions associated with the extraction, manufacturing, transportation, construction, replacement and disposal of building materials, or a portion of their total lifecycle. It will identify practical material substitutions, provide insights into cost implications, and highlight barriers and training needs for the broader adoption of low-embodied-carbon construction.

This stream pays up to \$10,000 for data from eligible projects.



NearZero

Powered by ZEIC

A research program with generous incentives to accelerate the decarbonization of BC homes

This website is for applicants to submit details for the incentive streams for which they may qualify.

Stream 1

Operational Emissions

[Learn More](#)

Stream 2

Embodied Emissions

[Learn More](#)

Stream 3

Domestic Hot Water

[Learn More](#)

Stream 4

Utility Data

[Learn More](#)

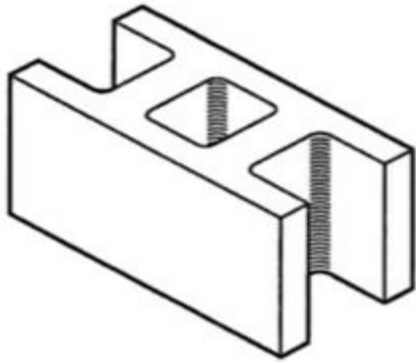




Understanding Life Cycle Assessment (LCA)

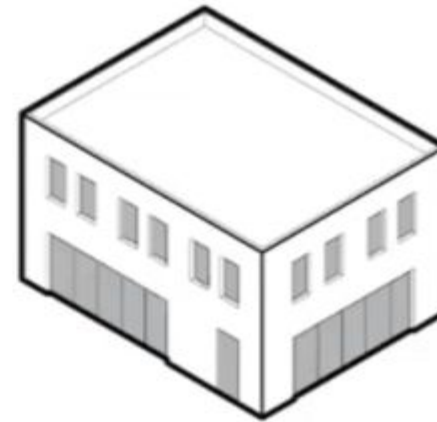
Product LCA

A **manufacturer** performs or commissions a **product LCA** to represent a specific product, often communicated in an EPD.



Project LCA

A project team (architect, engineer, green building consultant) performs a **building or infrastructure Project LCA** to represent a building, roadway, etc.



LCA Standards and Purpose

INTERNATIONAL
STANDARD

ISO
14040

Second edition
2006-07-01

**Environmental management — Life cycle
assessment — Principles and framework**

*Management environnemental — Analyse du cycle de vie — Principes
et cadre*

INTERNATIONAL
STANDARD

ISO
14044

First edition
2006-07-01

**Environmental management — Life cycle
assessment — Requirements and
guidelines**

*Management environnemental — Analyse du cycle de vie — Exigences
et lignes directrices*



ISO 14040

These internationally guidelines for creating LCAs that stakeholders can trust.

Provides the foundational principles and framework for LCAs.

Defines what a product life cycle is and provides high-level guidelines for each phase of the LCA process

Ensures a consistent approach



ISO 14044

Building on ISO 14040

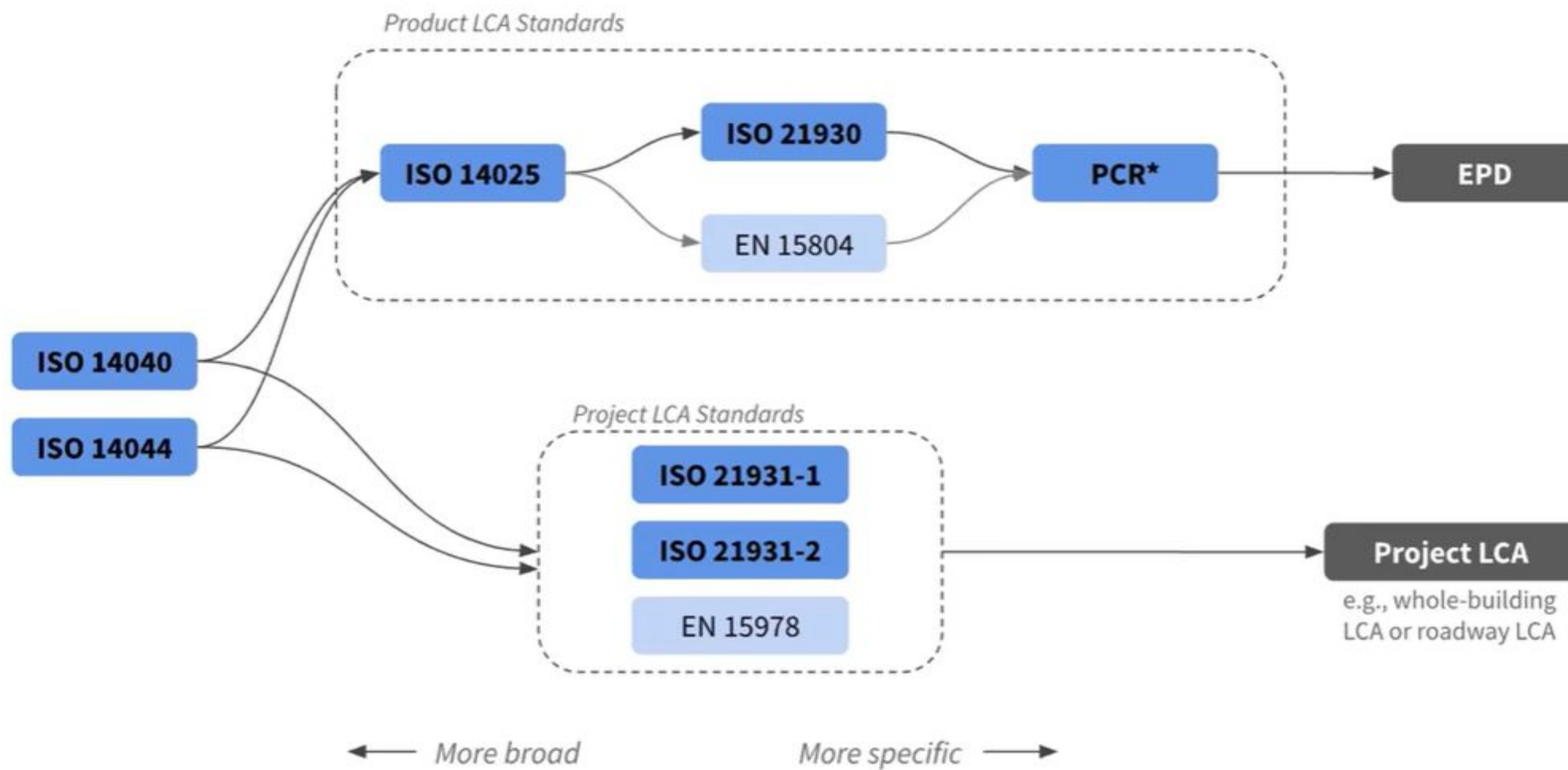
Deep dives into how to conduct an LCA

Detailed guidance for implementing each step of an LCA.

Has criteria for topics including data quality, impact categories and how to report results which makes sure the LCAs are credible and reliable.

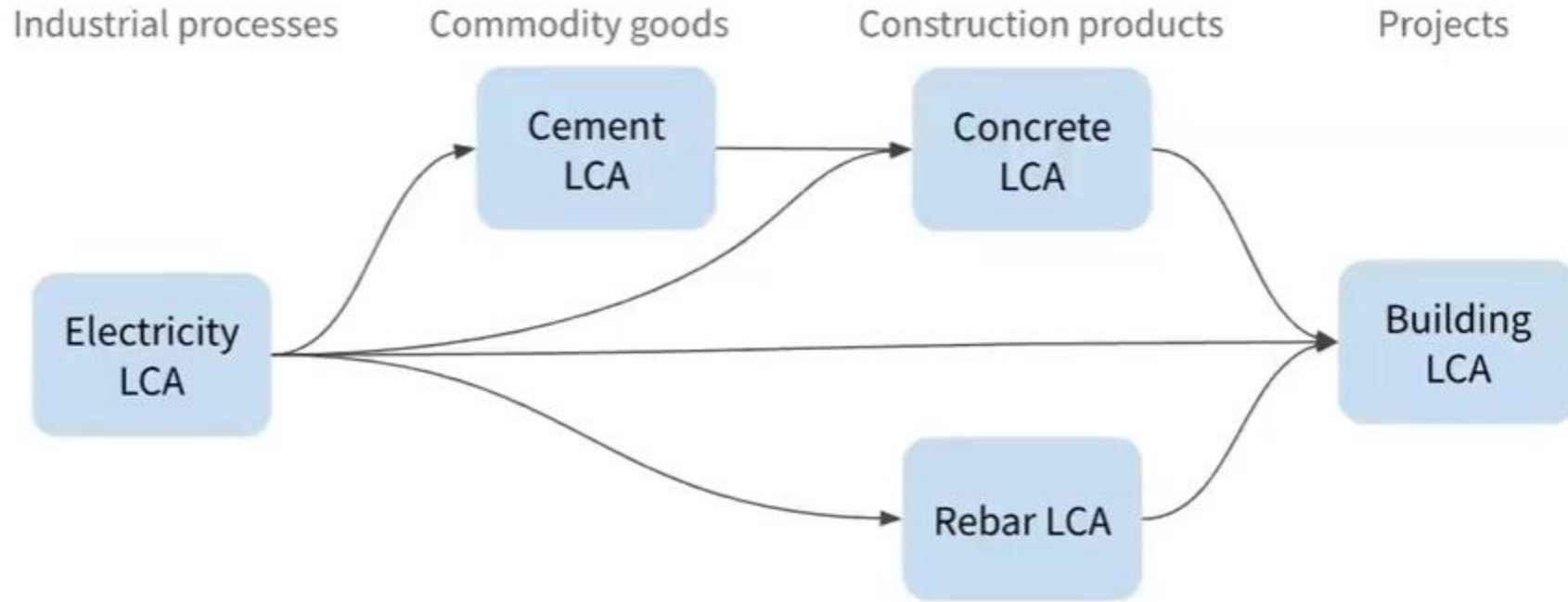


Structure of EPD Standards

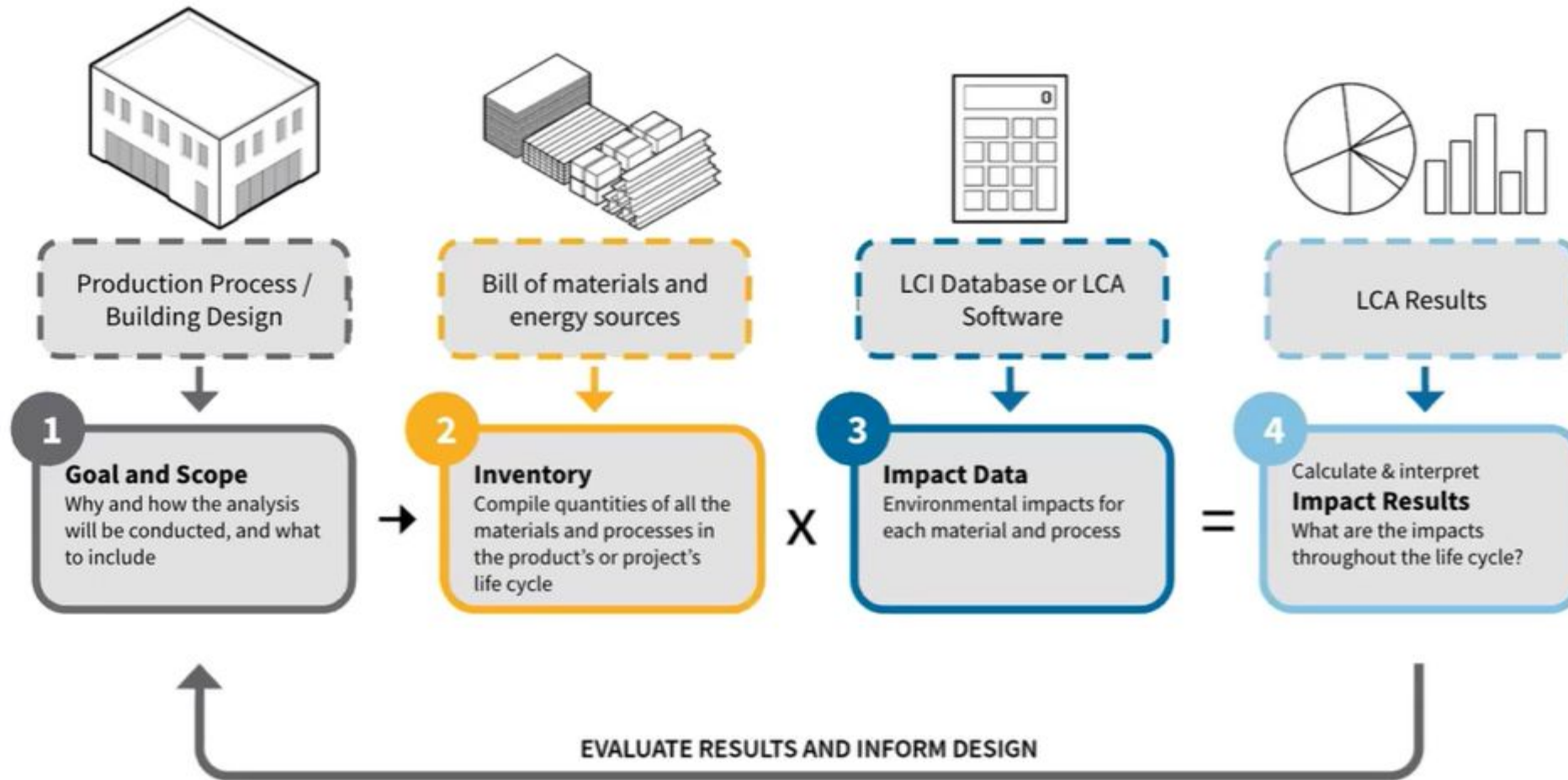


Nesting LCAs

The LCA of one product or process can become a building block for the LCA of a downstream product or process or project.



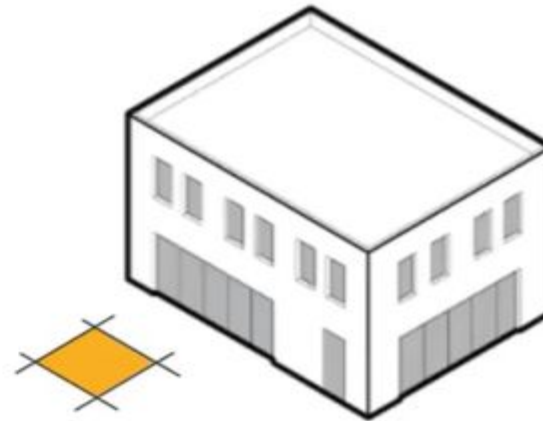
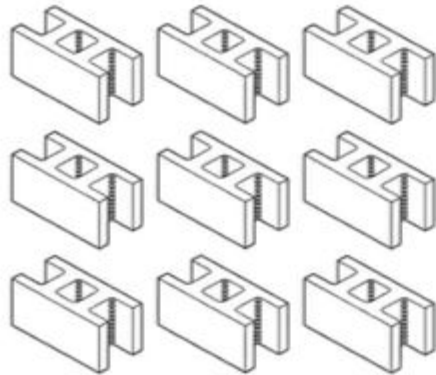
LCA Framework: What are the steps?



Goal and scope

Goal: What to assess and why.

Functional (or declared) unit:
unit of analysis for which the LCA
reports results



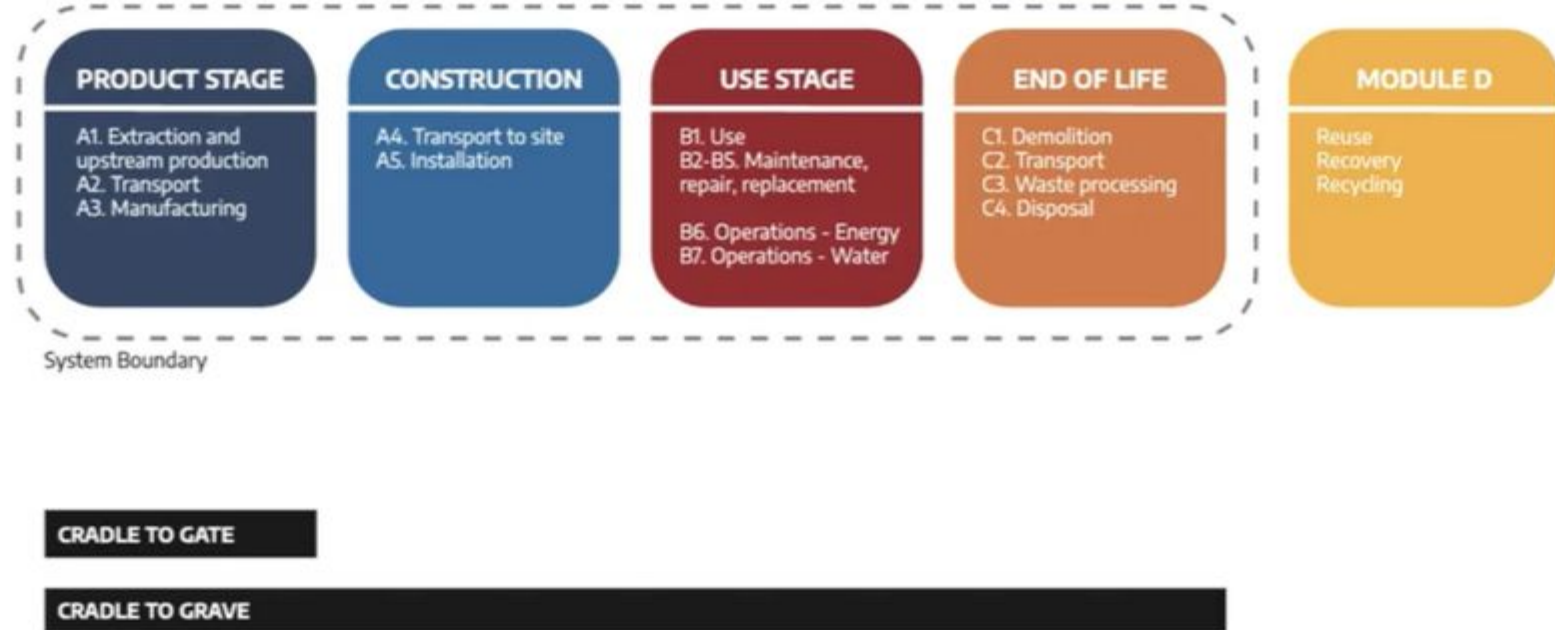
Goal and scope

Goal: What to assess and why.

Functional (or declared) unit:
unit of analysis for which the LCA reports results

System boundary:
What's included?

- Physical scope: *what stuff is included?*
- Temporal scope: *which **life cycle stages** are included?*



LCA Scope: Upfront Focus



Life cycle stages (adapted from LETI Embodied Carbon Primer, <https://www.leti.london/ecp>)

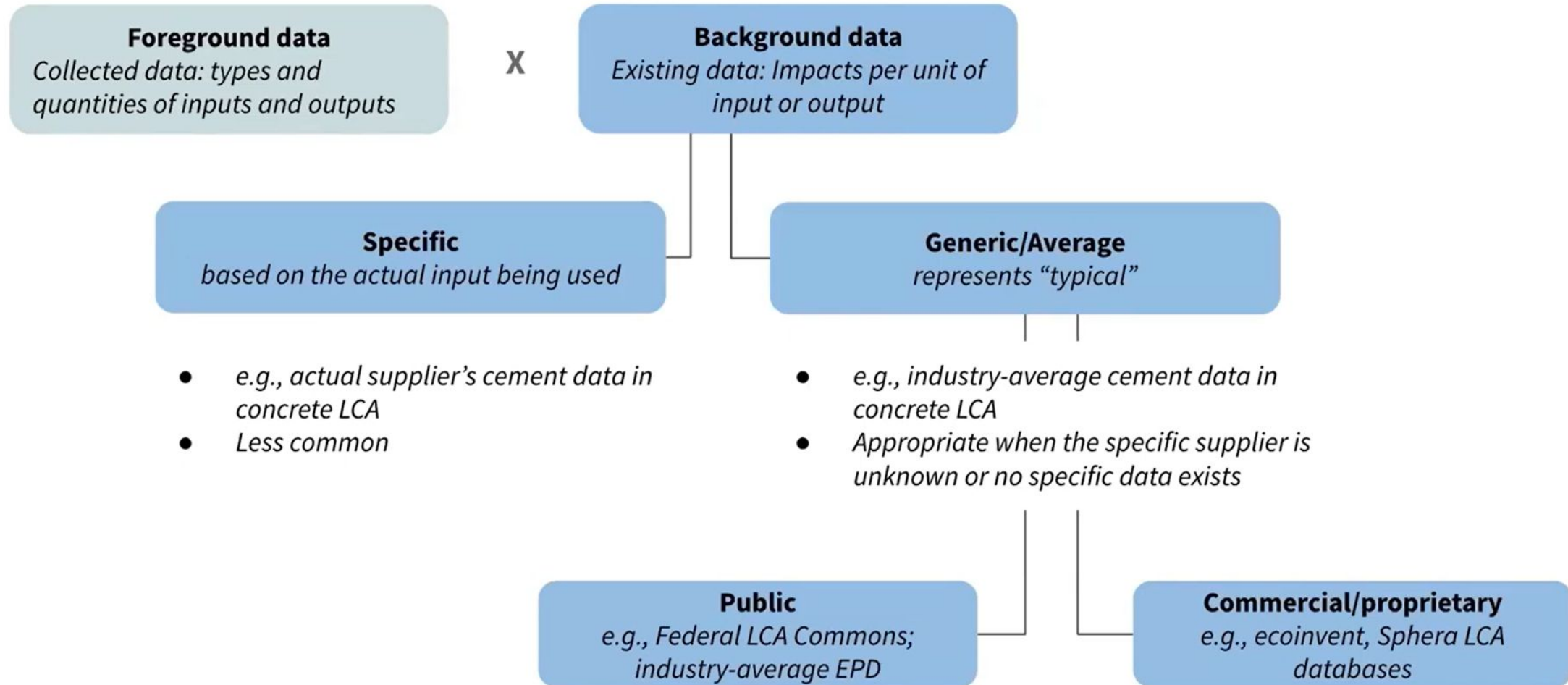


Data Types and Representativeness

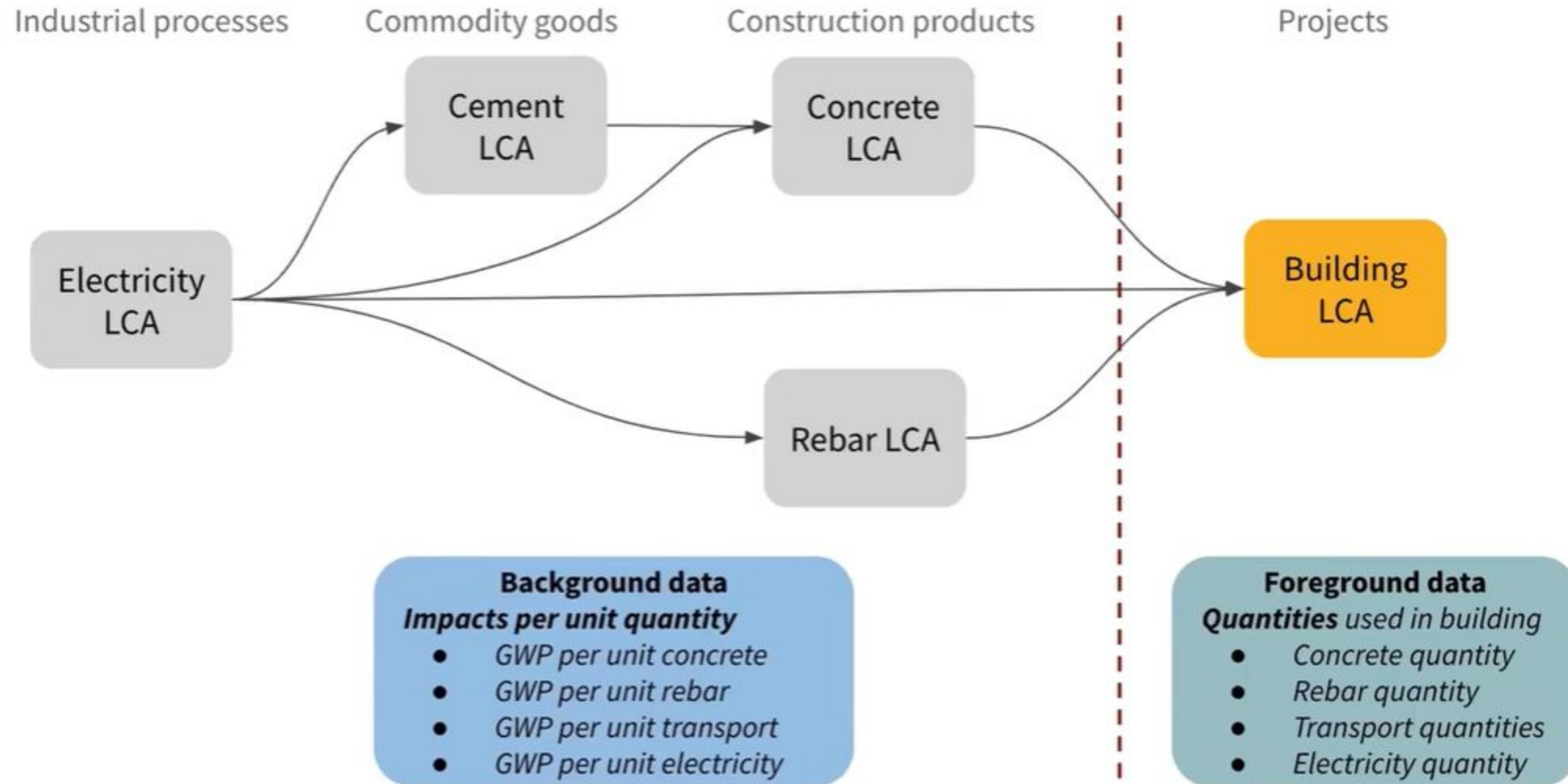
What type of information is available to start tracking/accounting?



Data Types and Representativeness



Foreground and Background Data



Foreground data <i>types and quantities of inputs / outputs</i>		Background data* <i>Impacts per unit of input or output</i>		Impacts <i>GWP Result</i>
Concrete, 10 m3	X	300 kg CO2e / m3 concrete	=	3,000 kg CO2e
Rebar, 1 tonne	X	800 kg CO2e / tonne	=	800 kg CO2e
Truck transport, 100 tonne-km	X	0.05 kg CO2e / t-km	=	5 kg CO2e
Grid electricity, 100 kWh	X	0.7 kg CO2e / kWh	=	70 kg CO2e
			Total	3,875 kg CO2e

*Background data shown represents Life Cycle Inventory (LCI) data times Life Cycle Impact Assessment (LCIA) characterization factors.

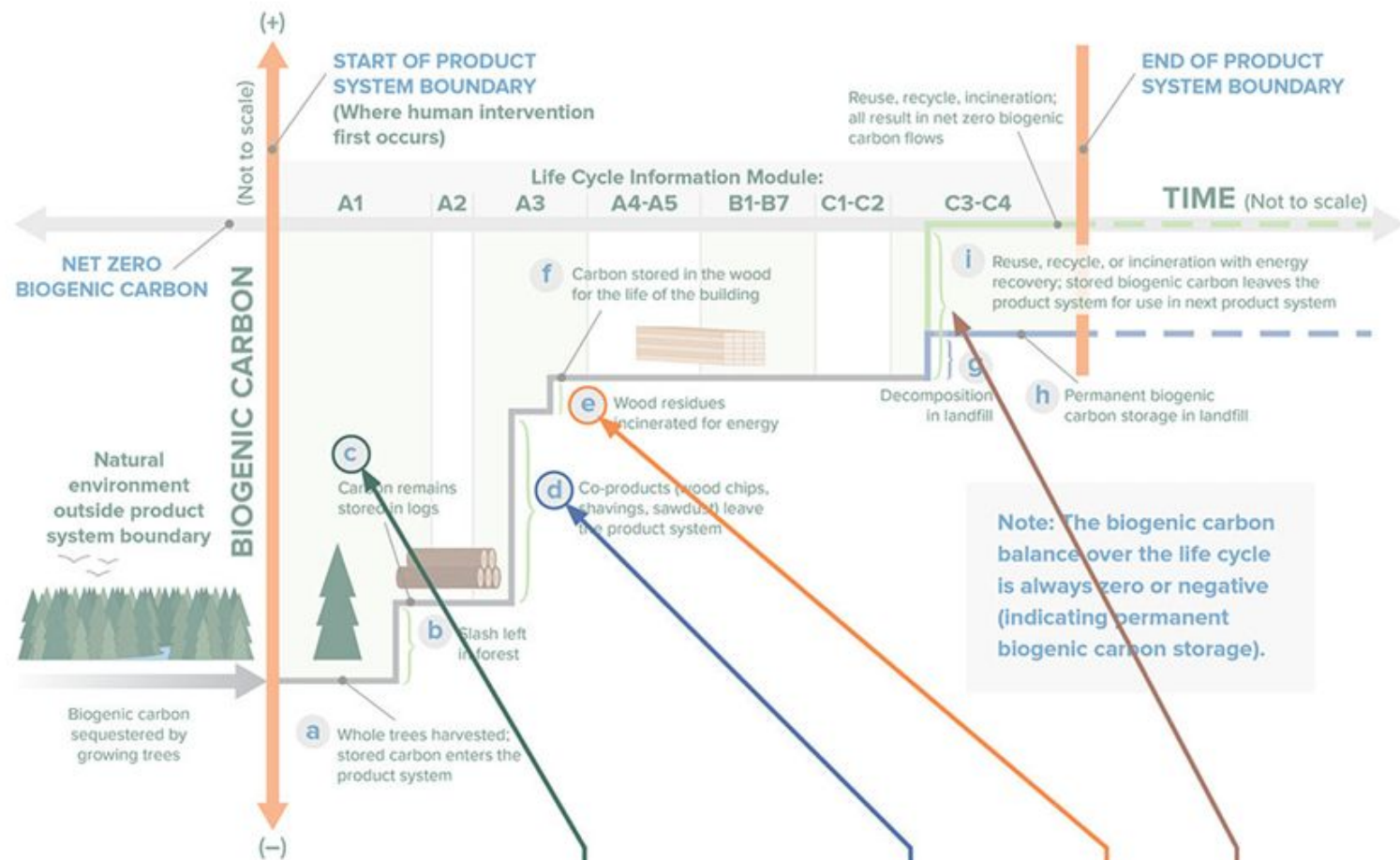
Biogenic Carbon Accounting

Produced in natural processes by living organisms, but not fossilized or derived from fossil resources.

Materials produced from renewable organic materials

Leading edge of carbon accounting





Parameter	Total	A1	A2	A3	A5	C3/C4
BCRP [kg CO ₂] Removal from product	(2,052.87)	(2,052.87)	0.00	0.00	0.00	0.00
BCEP [kg CO ₂] Emissions from product	1,868.67	0.00	0.00	1,025.02	0.00	843.66
BCRK [kg CO ₂] Removal from packaging	(1.35)	0.00	0.00	(1.35*)	0.00	0.00
BCEK [kg CO ₂] Emissions from packaging	0.75	0.00	0.00	0.00	0.75*	0.00
BCEW [kg CO ₂] Emission from combustion	184.80	0.00	0.00	184.80	0.00	0.00

*Biogenic carbon removals and emissions from packaging are not illustrated on the graphic above.

FIGURE 1 – North American softwood lumber carbon emissions and removals (Table 12) vs. biogenic carbon flows for wood products per ISO 21930 graphic





Environmental Product Declarations (EPDs)

EPD Definition and Verification

**Environmental Product Declarations (EPDs)
standardize the reporting of LCA results according to
the provisions of ISO 14025**

**EPDs are the primary source of data for embodied
carbon calculations**



EPD hierarchy

The Rules

PCR

The Analysis

LCA

The Report

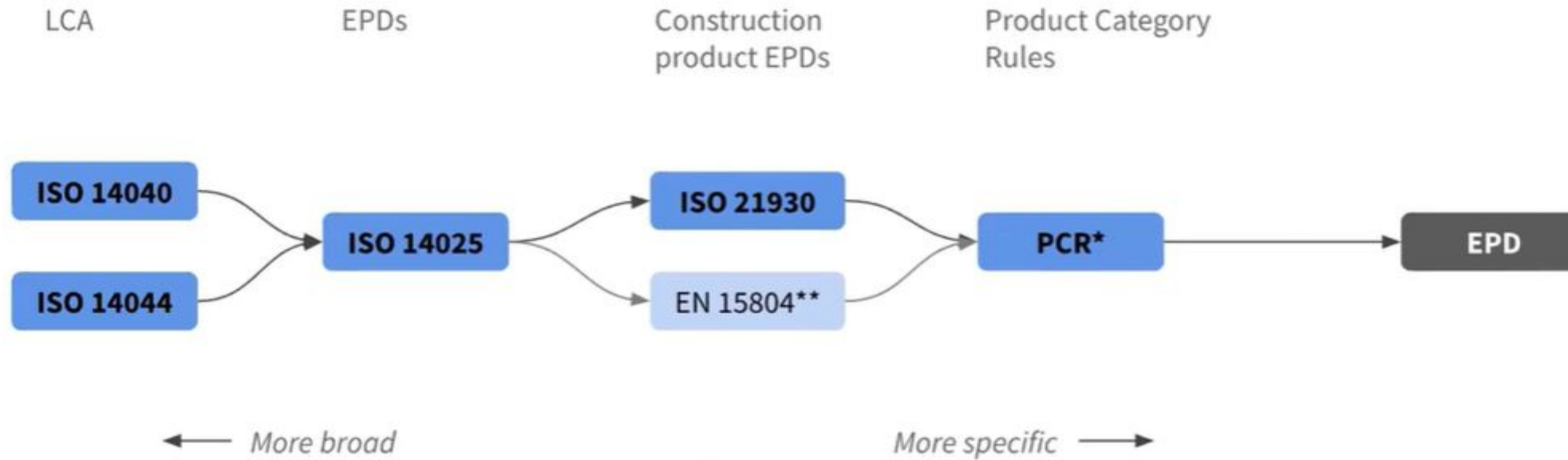
EPD

The Role of PCRs: EPD methodology is guided by a Product Category Rule (PCR)

PCR provides the rules for how this lifecycle assessment should be conducted, ensuring that the information in the EPD is reliable and comparable



Structure of EPD Standards



**Some program operators have both a more general “Part A” PCR for construction products and services and a more specific “Part B” or “subcategory” PCR.*

***EN 15804 is a parallel standard to ISO 21930 used in Europe and some other regions.*

EPD types and how they relate to embodied carbon policy

Product EPD*

*AKA “manufacturer-specific” EPD

Communicates the impacts of one manufacturer’s product or product family

Important for:

- reporting product GWP for Buy Clean
- comparing like products to each other or to a policy GWP limit
- data source to represent a particular product in a downstream LCA

Facility-specific

Product-specific

Industry-average EPD

AKA “industry-wide” EPD

Communicates typical impacts of a group of manufacturers for a range of similar products

Important for:

- setting policy GWP thresholds or limits
- data source to represent a typical product when more specific data isn’t desired or available
- tracking embodied carbon reductions achieved by an industry over time

EPD Development

Task		Responsible Party
1	Data Collection	Manufacturer
2	Product LCA / Background report / EPD preparation	Consultant / Manufacturer
3	3rd Party Verification	Verifier
4	EPD Publication	Program Operator
five-year validity (typical)		

Some North American Program Operators:

Smart EPD, UL Environment, NSF International, SCS Global Services, Sustainable Minds.

Industry Associations that also serve as program operators: NRMCA, NAPA

Alberta-Specific EPD Context

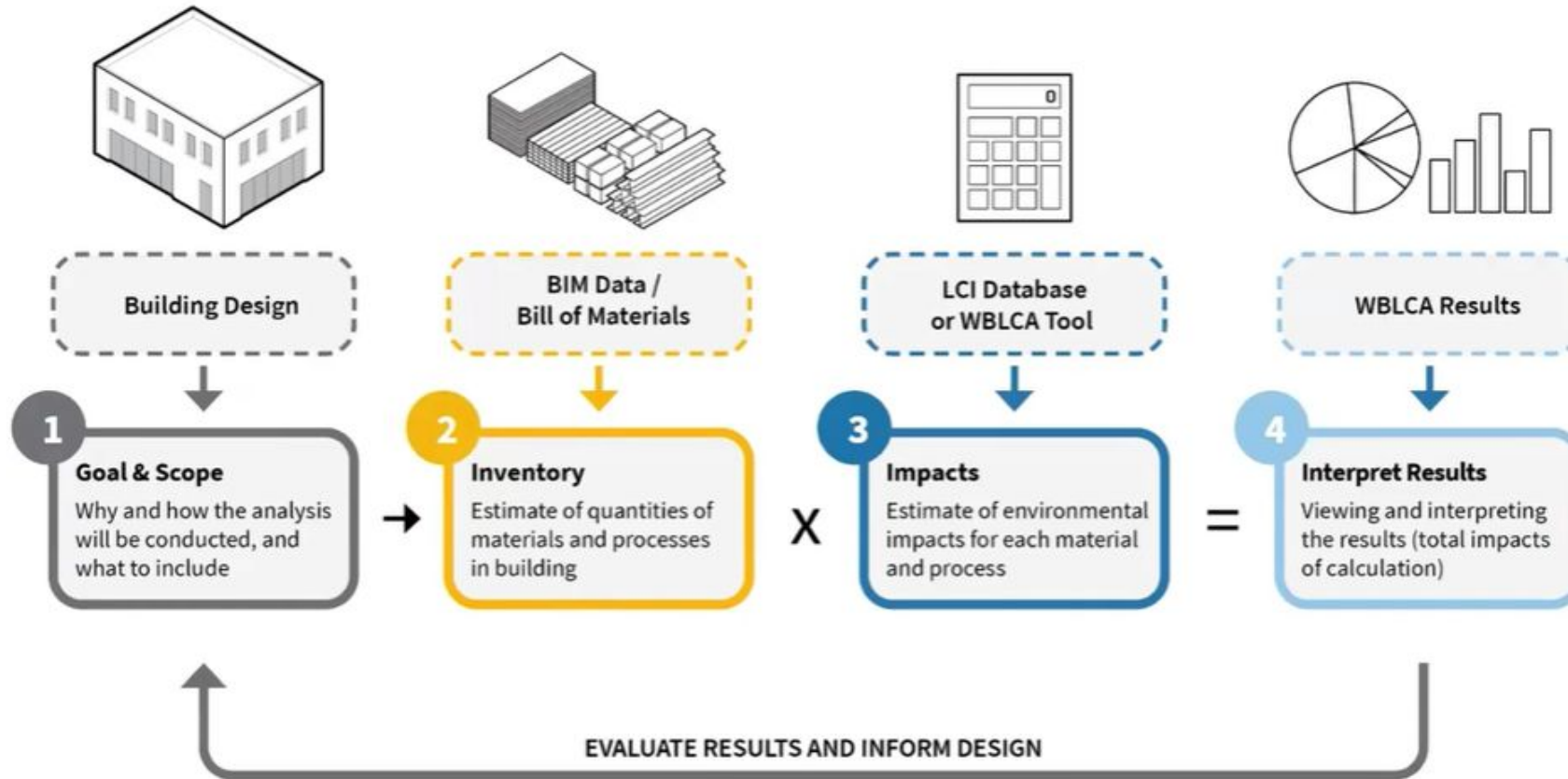




Practical Integration and Reduction Strategies

Reduction Strategies – Whole Building Life Cycle Assessment

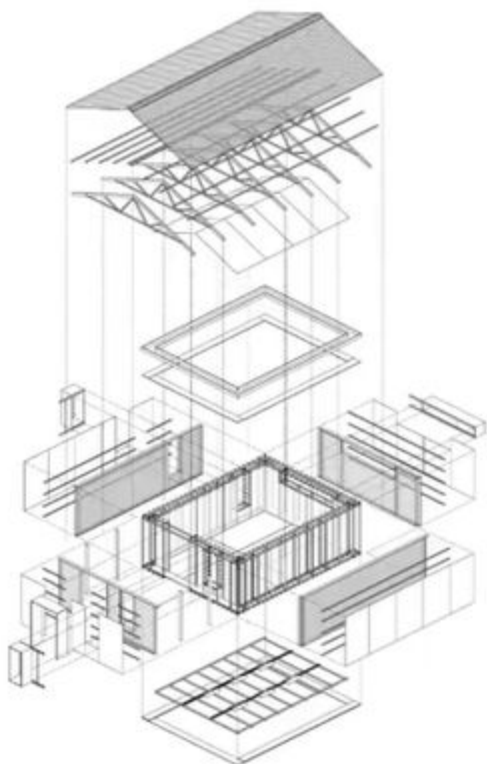
Steps of a WBLCA



1 Step 1: Define Goal and Scope

Physical Scope

How much physical stuff?



Building Elements:

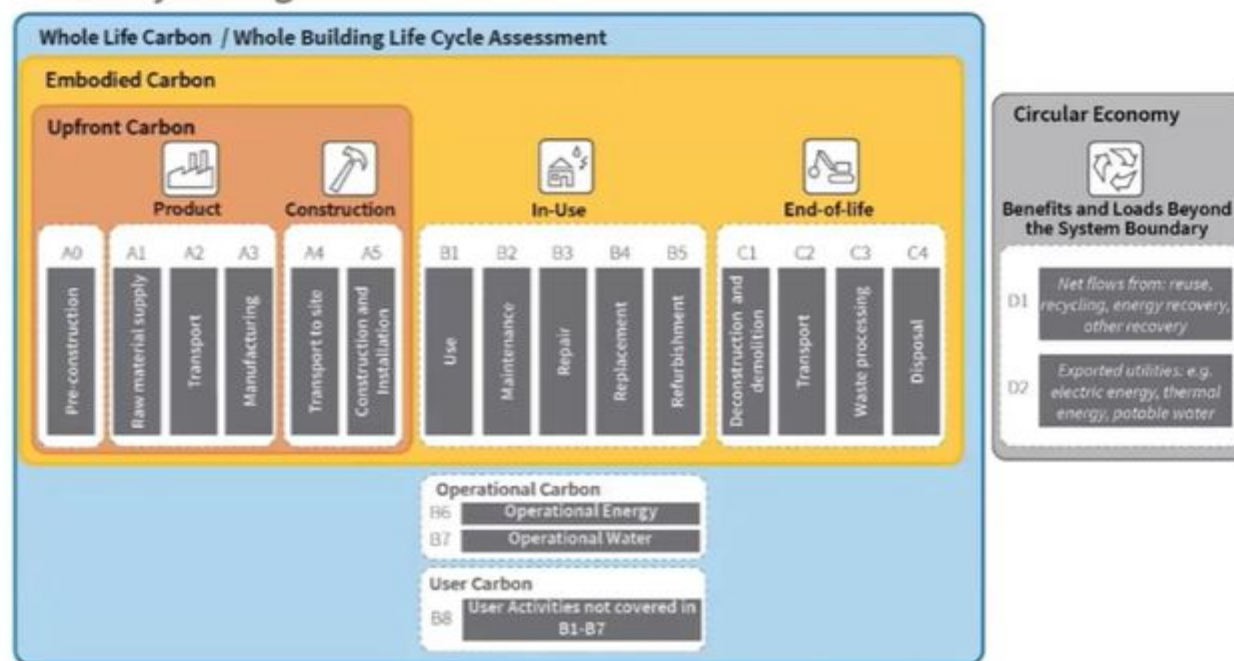
- Substructure
- Superstructure
- Enclosure
- Interiors
- Mechanical, Electrical, and Plumbing (MEP)
- Sitework
- Furnishings, fixtures, and equipment (FF&E)

Image Source: Allies and Morrison
<https://www.alliesandmorrison.com>

Temporal Scope

Which parts of the building's life cycle?

Life Cycle Stages:



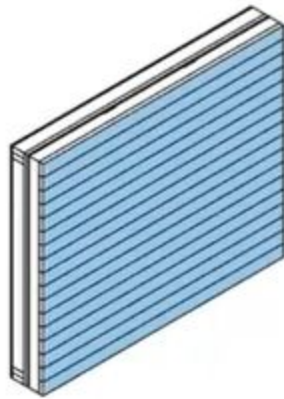
© Copyright 2024, Carbon Leadership Forum

Source: Life cycle modules and stages per EN15978 and ISO21931-1.
Graphically adapted from RICS Whole Life Carbon Assessment (2nd Edition)
by The Carbon Leadership Forum.

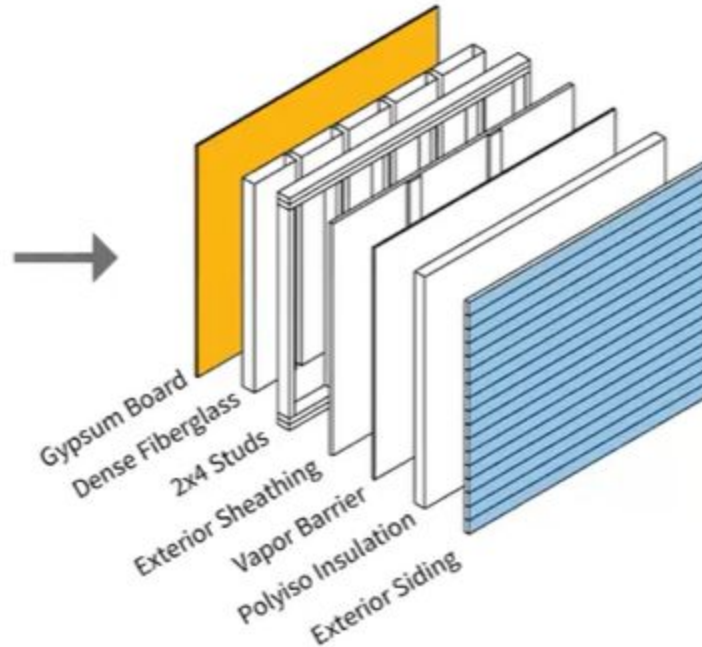
2

Step 2: Collect Inventory

For example:
a single “wall”



can be made of
dozens of materials



which can be summarized into
discrete material quantities

Material	Quantity	Unit
Gypsum Board	xx	kg
Dense Fiberglass	xx	kg
2x4 Studs	xx	kg
Exterior Sheathing	xx	kg
Vapor Barrier	xx	kg
Polyiso Insulation	xx	kg
Exterior Siding	xx	kg

...LCA tools help automate this process...

Step 3: Impact Assessment

Material	Quantity	Unit
Gypsum Board	xx	kg
Dense Fiberglass	xx	kg
2x4 Studs	xx	kg
Exterior Sheathing	xx	kg
Vapor Barrier	xx	kg
Polyiso Insulation	xx	kg
Exterior Siding	xx	kg

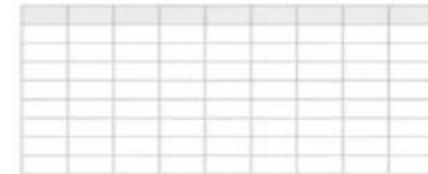
The diagram illustrates a wall assembly cross-section with the following layers from top to bottom:

- Gypsum Board**: Represented by a solid yellow square.
- Dense Fiberglass**: Represented by a square with vertical grey stripes.
- 2x4 Studs**: Represented by a square with vertical white stripes.
- Exterior Sheathing**: Represented by a square with horizontal grey stripes.
- Vapor Barrier**: Represented by a solid white square.
- Polyiso Insulation**: Represented by a square with vertical grey stripes.
- Exterior Siding**: Represented by a square with horizontal blue stripes.

Each layer is connected by a line to a rounded rectangular box containing the text: "Environmental impact data for product / material".

Totals and/or summaries of:

- Global Warming Potential (GWP)
 - Aka “carbon”
- Acidification Potential
- Eutrophication Potential
- Smog Formation Potential
- Ozone Depletion Potential
- Etc.



...LCA tools help automate this process...



Step 4: Interpret Results

Typical WBLCA results include:

- Summarized totals for all environmental impacts
 - Global warming (carbon), acidification, ozone depletion, eutrophication, smog formation, etc.
- Various graphic outputs and breakdowns:
 - Impacts by life cycle stages, material categories, elements, or other categories

Typical goals of interpretation:

- Identify “hotspots”
- Check for errors
- Understand the results
- Develop conclusions
- Verify results
- Ultimately, inform design decision making

Example: Tally LCA tool results output

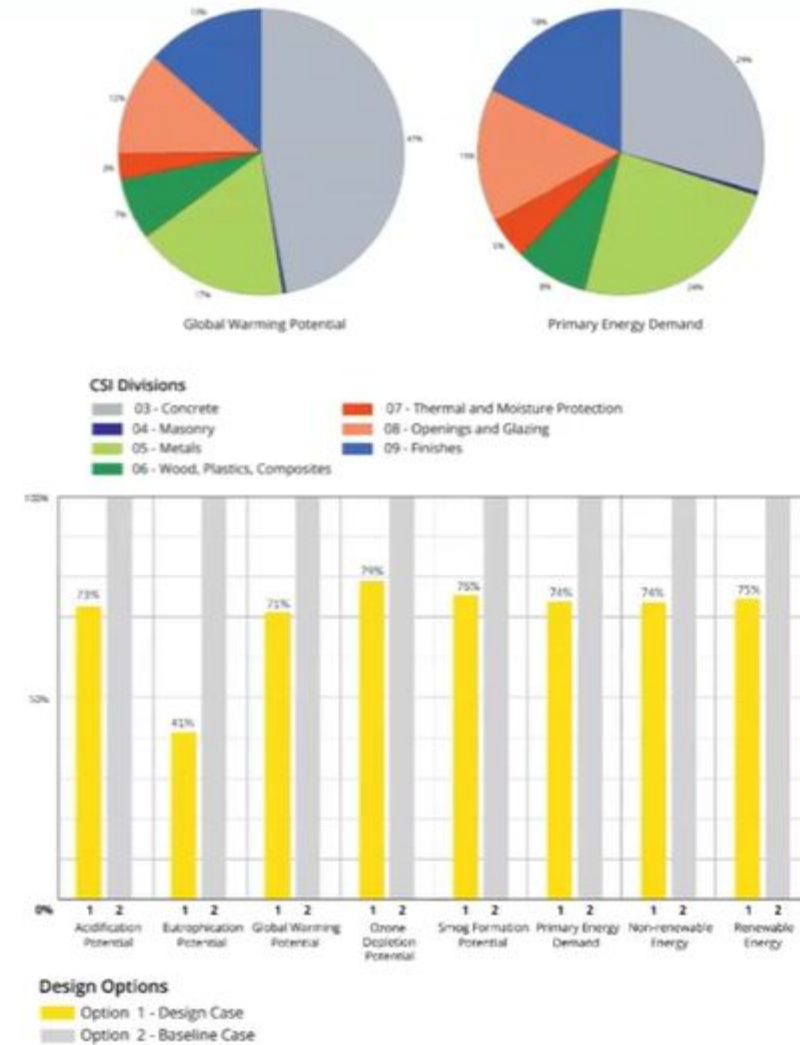
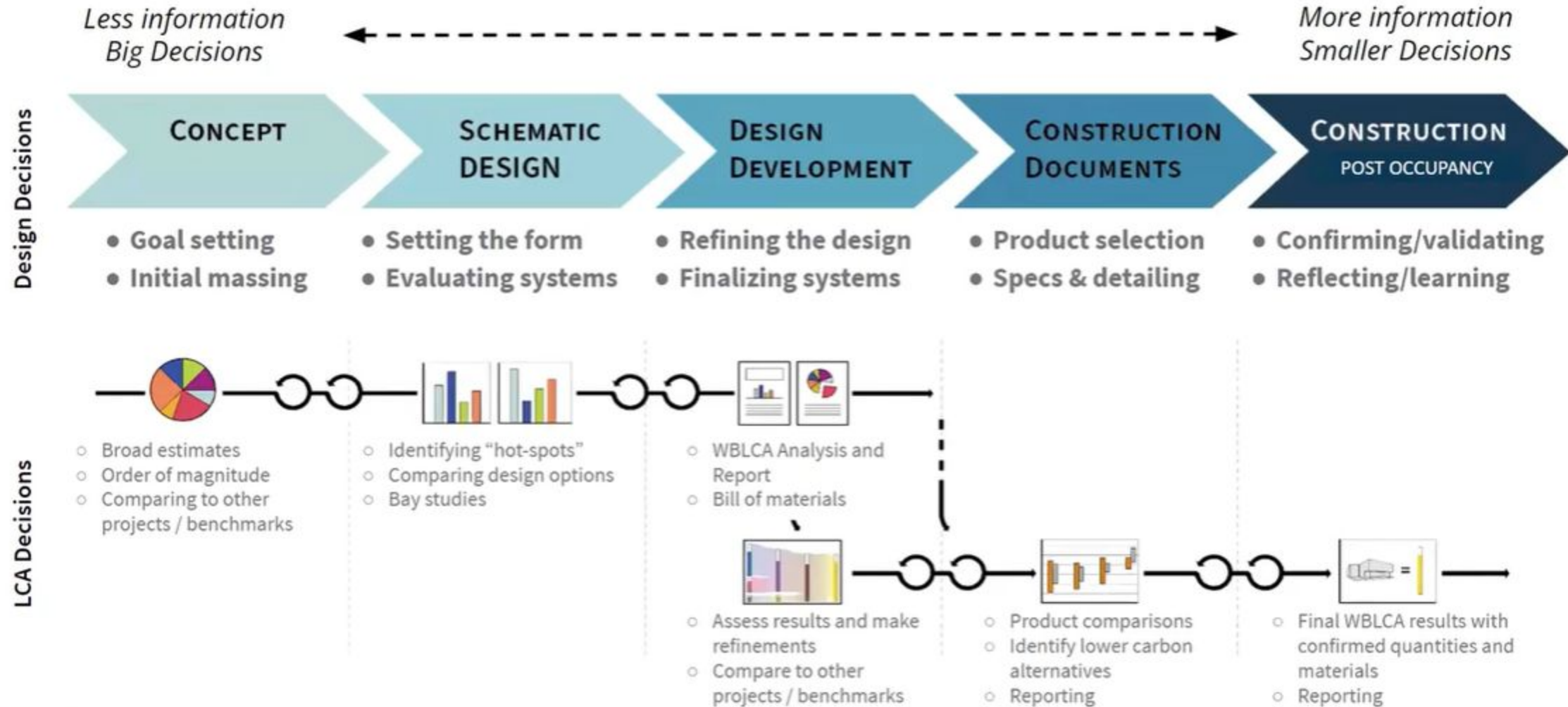


Image Source: Tally LCA Software
<https://choosetally.com/casestudy/>

Design Decision Making - LCA Throughout the Project Timeline



Design Decision Making - LCA Tools for Buildings

Less Accurate
Less time consuming
Generic Data

← ----- →

More Accurate
More time consuming
Specific Data

Category

LCA / Carbon Calculators

- Easy to use & repeatable
- Limited inputs needed
- Industry-wide data
- Examples:
 - EPIC
 - BEAM
 - CARE
 - Upstream
 - Pathfinder

Tool Criteria

Design-integrated WBLCA Software

- Highly flexible, custom questions
- Full physical and temporal scope
- Industry-wide or product-specific data
- Examples:
 - Tally LCA
 - OneClick LCA
 - Athena Impact Estimator
 - BHoM
 - Cove.io

Product Selection and Procurement

- High-resolution & accurate
- Specific material quantities
- Product/facility specific data
- Examples:
 - EC3
 - PHANOS (European focus)
 - Okubaudat (European focus)
 - BECD (European focus)

Carbon Calculators

Welcome



**BUILDING EMISSIONS
ACCOUNTING**
FOR MATERIALS



Tools



Government
of Canada

Gouvernement
du Canada

MENU ▾

[Canada.ca](#) > [Natural Resources Canada](#) > [Maps, tools, publications](#) > [Tools and applications](#)

Material Carbon Emissions Estimator (MCE2)

Material Embodied Carbon

EXTRACTION + TRANSPORTATION + MANUFACTURING
Stages A1-A3 of Life Cycle Assessment



"Cradle to Gate" Emissions

Material embodied carbon



DESIGN & CONSTRUCTION — NORTH AMERICA

LCA software to reduce embodied carbon in your projects

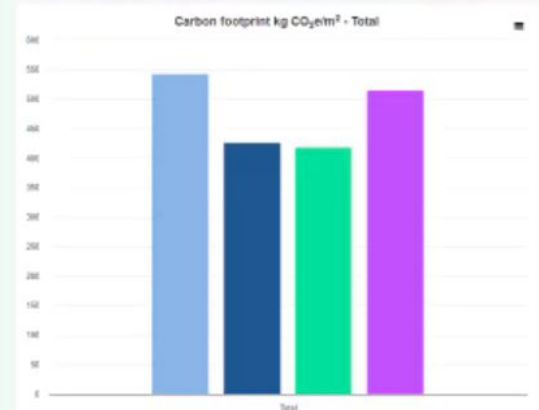
Decarbonize and meet client requirements, certifications like LEED, and code compliance with the world's leading LCA software for the industry.

Carbon Designer 3D > Project 1

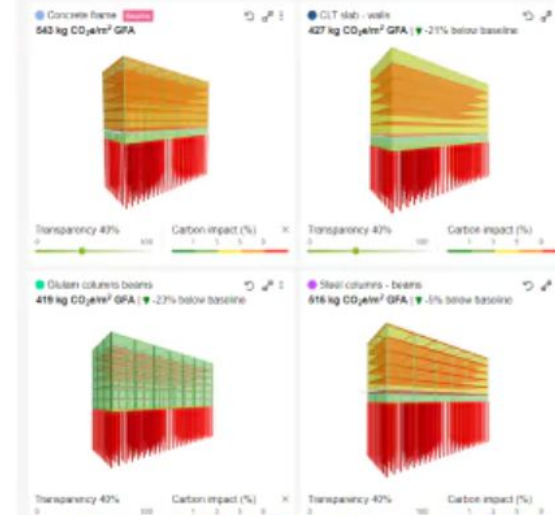
General Information

Carbon footprint, Tn CO₂e

By Element	By Material	By Characteristic
Concrete frame	CLT slab - walls	CLT slab - walls
543 kg CO ₂ e/m ² GFA	427 kg CO ₂ e/m ² GFA	427 kg CO ₂ e/m ² GFA
419 kg CO ₂ e/m ² GFA	419 kg CO ₂ e/m ² GFA	419 kg CO ₂ e/m ² GFA
	Steel columns - beams	Steel columns - beams
	616 kg CO ₂ e/m ² GFA	616 kg CO ₂ e/m ² GFA



3D View



Where can we focus for highest impact?

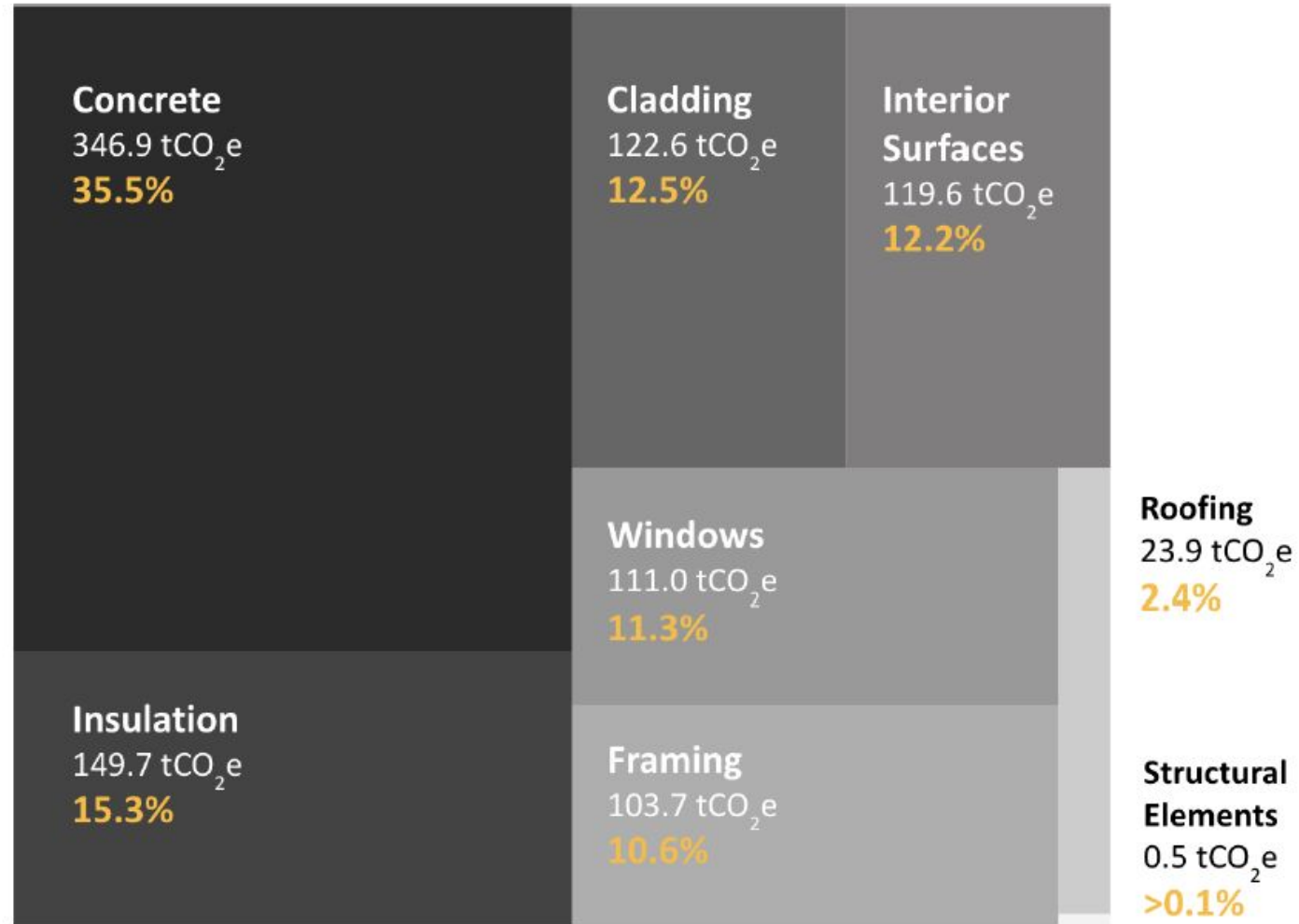
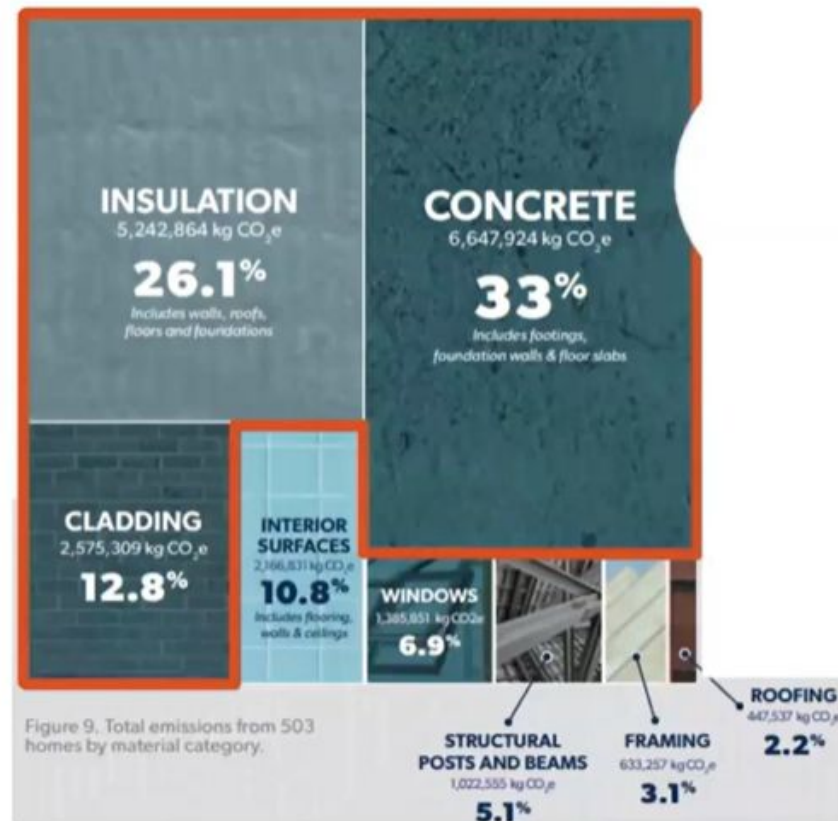


image from Builders for Climate Action – Establishing the Average Upfront Material Carbon Emissions in New Low-Rise Residential Home Construction in the City of Nelson & the City of Castlegar



Which materials have highest impacts? (503 residential homes in Toronto, Canada)



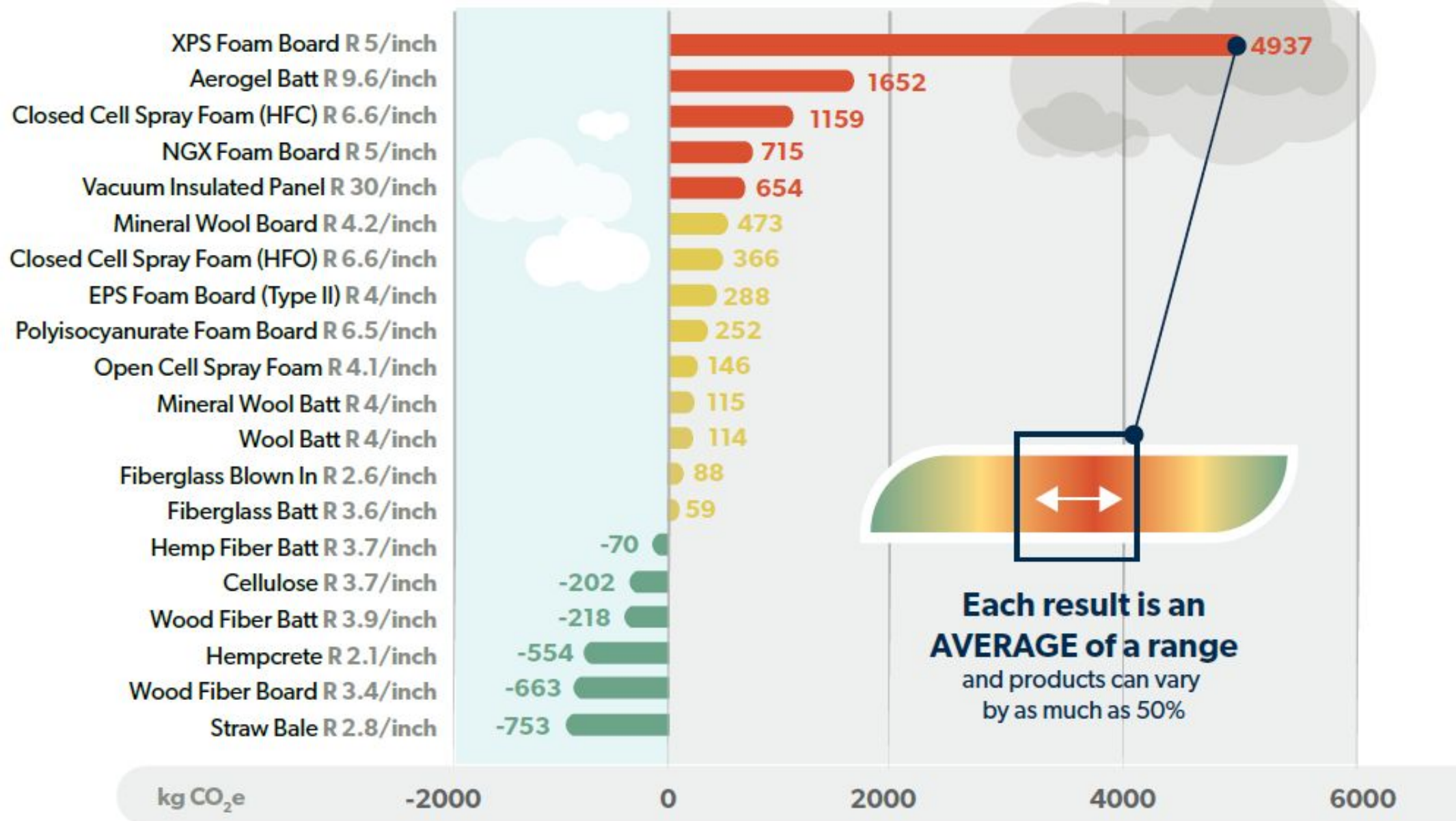
*Modeled material impacts
for 503 residential homes
in the Toronto, Canada
area*

Figure 9. Total emissions from 503 homes by material category.

Concrete Mix	GWP Factor kg CO ₂ e/m ³	Emissions from 503 samples, kg CO ₂ e	Percentage change from benchmark
CRMCA - 0-25 MPa, Canadian Benchmark Avg.	305	4,269,344*	
Butler Concrete N254	124	1,738,469	-59%
LaFarge ECOPact RMXUG35A3A8M	170	2,383,385	-44%
CRMCA Mix #19 - 0-25 MPa, 35-50% Slag, GUL	214	3,000,260	-30%
CRMCA Mix #18 - 0-25 MPa, 35-50% Slag, GU	234	3,280,660	-23%
CRMCA Mix #10 - 0-25 MPa, 30-40% Fly Ash, GU	250	3,50,478	-18%
CRMCA Mix #12 - 0-25 MPa, 25-34% Slag, GU	268	3,757,337	-12%
CRMCA Mix #6 - 0-25 MPa, 15-29% Fly Ash, GU	283	3,967,635	-7%
CRMCA Mix #1 - 0-25 MPa, 0-14% FA/SL, GU	327	4,584,512	+7%
EC3 Avg. for 107 Canadian 25 MPa concrete EPDs	390	5,467,766	+28%
EC3 Conservative estimate for Canadian 25 MPa	507	7,108,096	+66%
LaFarge RMXK925A21F	610	8,552,147	+100%

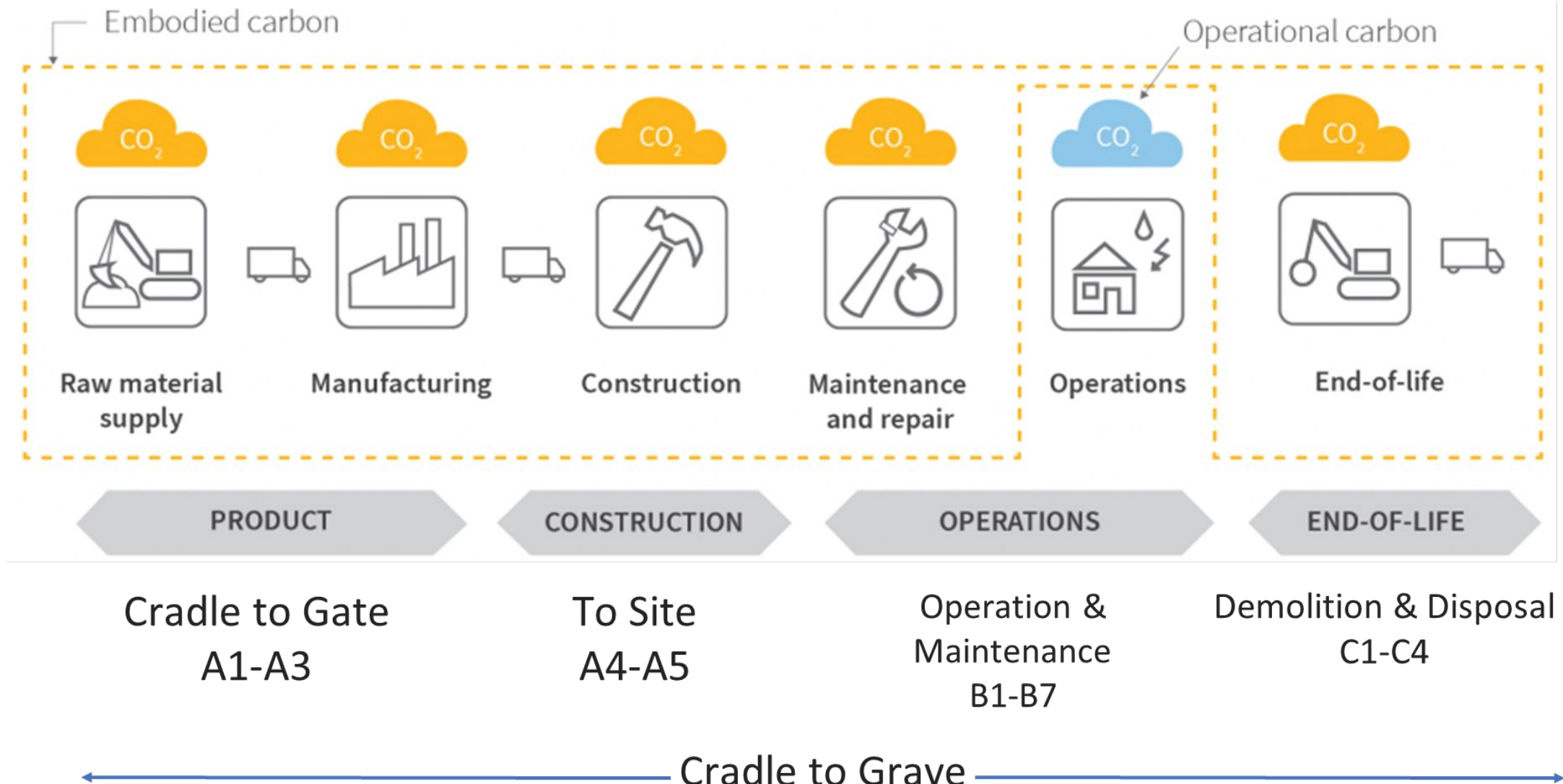


Insulation Emissions Comparison for 100 m² @ R5



Embodied Carbon

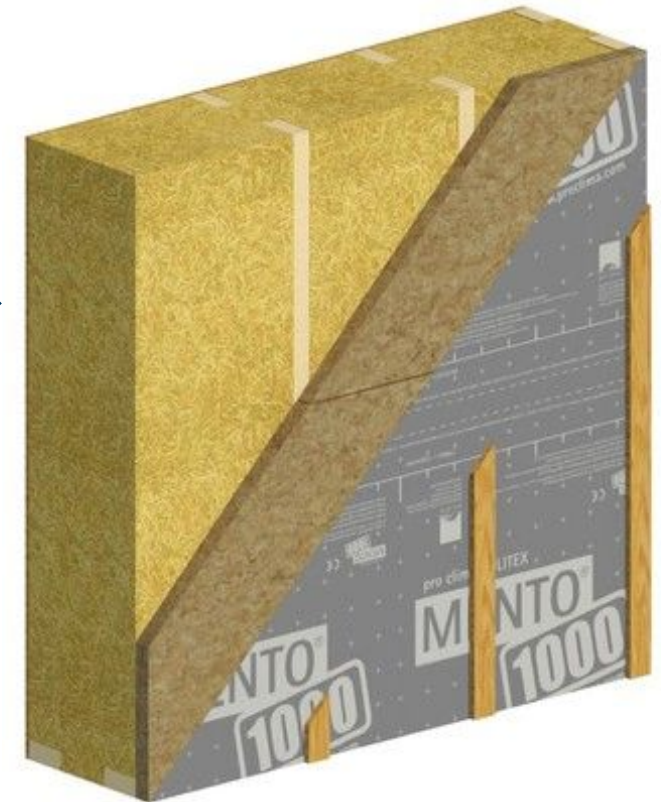
Embodied Carbon



Sustainable Insulation Products: Straw

- Straw is a carbon storing material
- Products such as panelized straw walls and blown chopped straw walls have lower embodied carbon emissions

Example from BEAM Embodied Carbon calculator:



Reference: <https://www.savick.ca/panels>

CATEGORY	MATERIAL	QUANTITY	UNITS	%	SELECT	NET EMISSIONS kg CO ₂ e
COMPOSITE SIP PANELS						
	Straw Insulated Panels with wood framing (SIP) / EcoCocon / Prefabricated panel, 40 cm / R35 [EU]	100.0	m ²	100%	☐	-7,068

Sustainable Insulation Products: Wood Fibre Board

- Wood fiber board insulation is a carbon storing material



Reference: <https://wood100.ca/wood-fibre-insulation/>

Sustainable Insulation Products: Wood Fibre Board

Example from BEAM Embodied Carbon calculator:

CATEGORY	MATERIAL	QUANTITY	UNITS	%	SELECT	NET EMISSIONS kg CO ₂ e	GROSS EMISSIONS kg CO ₂ e	STORAGE Short Cycle kg CO ₂ 🖐️
WOOD FIBER BOARD								
	Wood fiber board / R 2.7-inch / NAFA [Industry Avg US & CA]	100.0	m ²	100%	☐	-1,817	1,873	3,690
	Wood fiber board / Pavatex / Pavatherm / R 3.3-inch / 110 kg/m3 [EU]	100.0	m ²	100%	☐	-269	1,104	1,373
	Wood fiber board / Steico / STEICOprotect S dry, STEICOsafe 40, STEICOuniversal dry / R 3.6-inch, 210 kg/m3 [EU]	100.0	m ²	100%	☐	-317	2,007	2,325
	Wood fiber board / Steico / STEICOprotect M dry, STEICOroof dry, STEICOspecial dry, STEICOtop / R 3.6-inch, 140 kg/m3 [EU]	100.0	m ²	100%	☐	-403	1,146	1,550
	Wood fiber board / Steico / STEICOtherm dry, STEICOprotect L dry, STEICOsafe / R 3.6-inch, 110 kg/m3 [EU]	100.0	m ²	100%	☐	-440	777	1,218
	Wood fiber board / Pavatex / Pavawall Smart, Pavawall Light, Pavawall FW / R 3.3-inch / 115 kg/m3 [EU]	100.0	m ²	100%	☐	-963	426	1,388
	Wood fiber board / GUTEX / Multi-Therm / R 3.6-inch, 40-200 mm [EU]	100.0	m ²	100%	☐	-1,000	546	1,546

Wood Fibre Board vs. Other Continuous Insulation Products

Example from BEAM Embodied Carbon calculator:

CATEGORY	MATERIAL	QUANTITY	UNITS	%	SELECT	NET EMISSIONS kg CO ₂ e	GROSS EMISSIONS kg CO ₂ e	STORAGE Short Cycle kg CO ₂ 🖐️
WOOD FIBER BOARD								
	Wood fiber board / R 2.7-inch / NAFA [Industry Avg US & CA]	100.0	m ²	100%	☐	-1,817	1,873	3,690
XPS FOAM BOARD								
	XPS foam board / R 5.0/inch [BEAM Avg US & CA]	100.0	m ²	100%	☐	962	962	0
	XPS foam board / Owens Corning / Foamular NGX CodeBord/C200 / R 5/inch, 20 psi	100.0	m ²	100%	☐	1,499	1,499	0
EPS FOAM BOARD								
	EPS foam board / Type II / R 4.0-inch, 15 psi / EPS Industry Alliance [Industry Avg US & CA]	100.0	m ²	100%	☐	604	604	0
MINERAL WOOL BOARD								
	Mineral wool board - heavy density / NAIMA / R 4.4-inch [Industry Avg N.America]	100.0	m ²	100%	☐	1,201	1,201	0

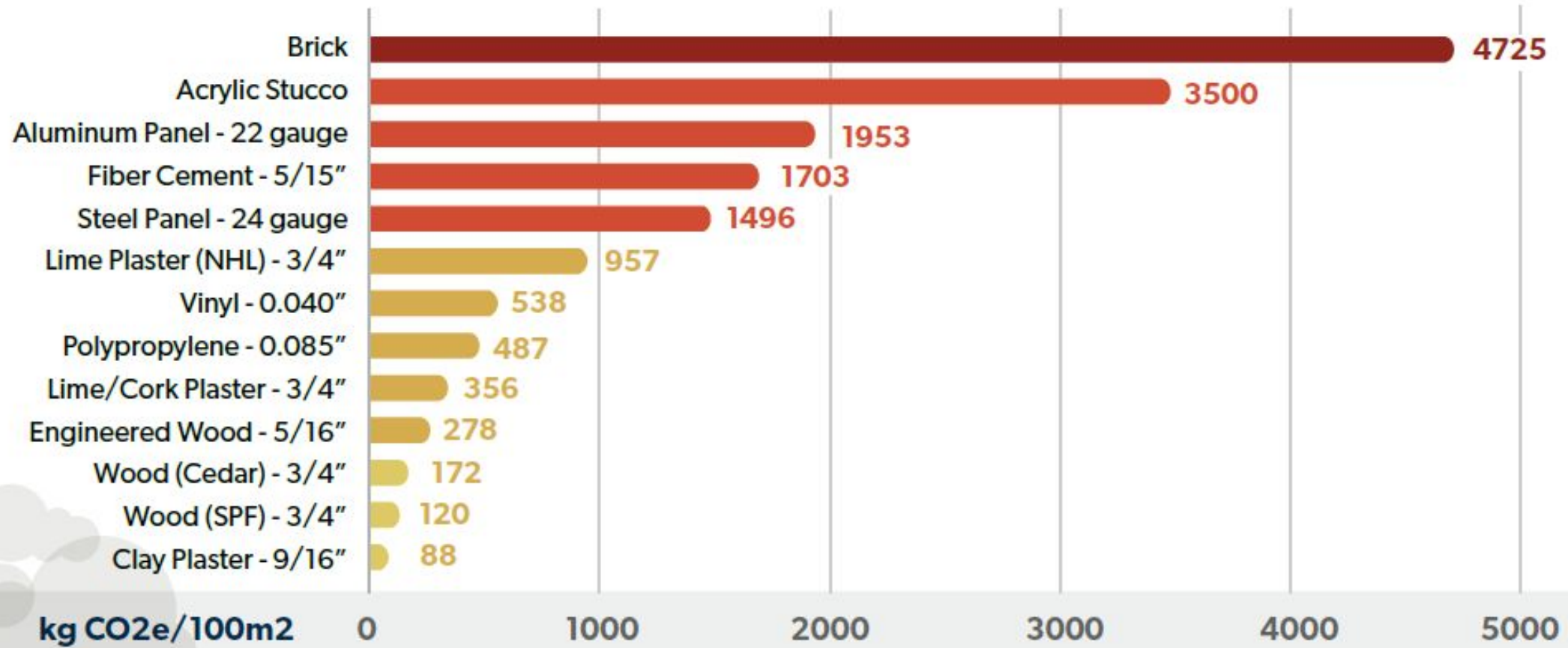
Considerations for Insulation Selection

- R-Value
- Cost
- Product Availability
- Moisture Management
- Embodied Carbon
- Constructability
- Trades' Knowledge
- Other Design Factors

Cost and MCE Comparison of Wall Cavity Insulation Options				
Wall Cavity Insulation	Type	R/inch	kgCO ₂ e for 10 m ² @ R10	Cost for 10 m ² @ R10
	Straw bale	3.3	-128	\$49.11
	Hempcrete	2.1	-76	\$213.15
	Hemp fiber batt	3.7	-31	\$96.33
	Wood fiber batt	3.8	-19	\$210.33
	Cellulose batt	3.6	-14	\$70.79
	Cellulose dense packed	3.7	-13	\$40.83
	Fiberglass batt	3.6	12	\$55.47
	Mineral wool batt	3.8	23	\$75.84
	Wool batt	3.6	23	\$133.93
	ccSPF with HFO blowing agent	6.6	73	\$11.73
	ccSPF with HFC blowing agent	6.6	232	\$10.66

Reference: Achieving Real Net-Zero Emission Homes Report, 2021 Natural Resources Canada & Builders for Climate Action

Cladding Emissions, kg CO₂e/100m²





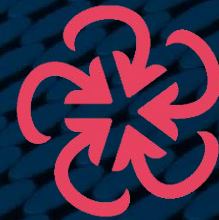
Thank you

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Three Actions:

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- Attend a CLF AB session
- Check out the resources page

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