We will be starting soon!

Thanks for joining us

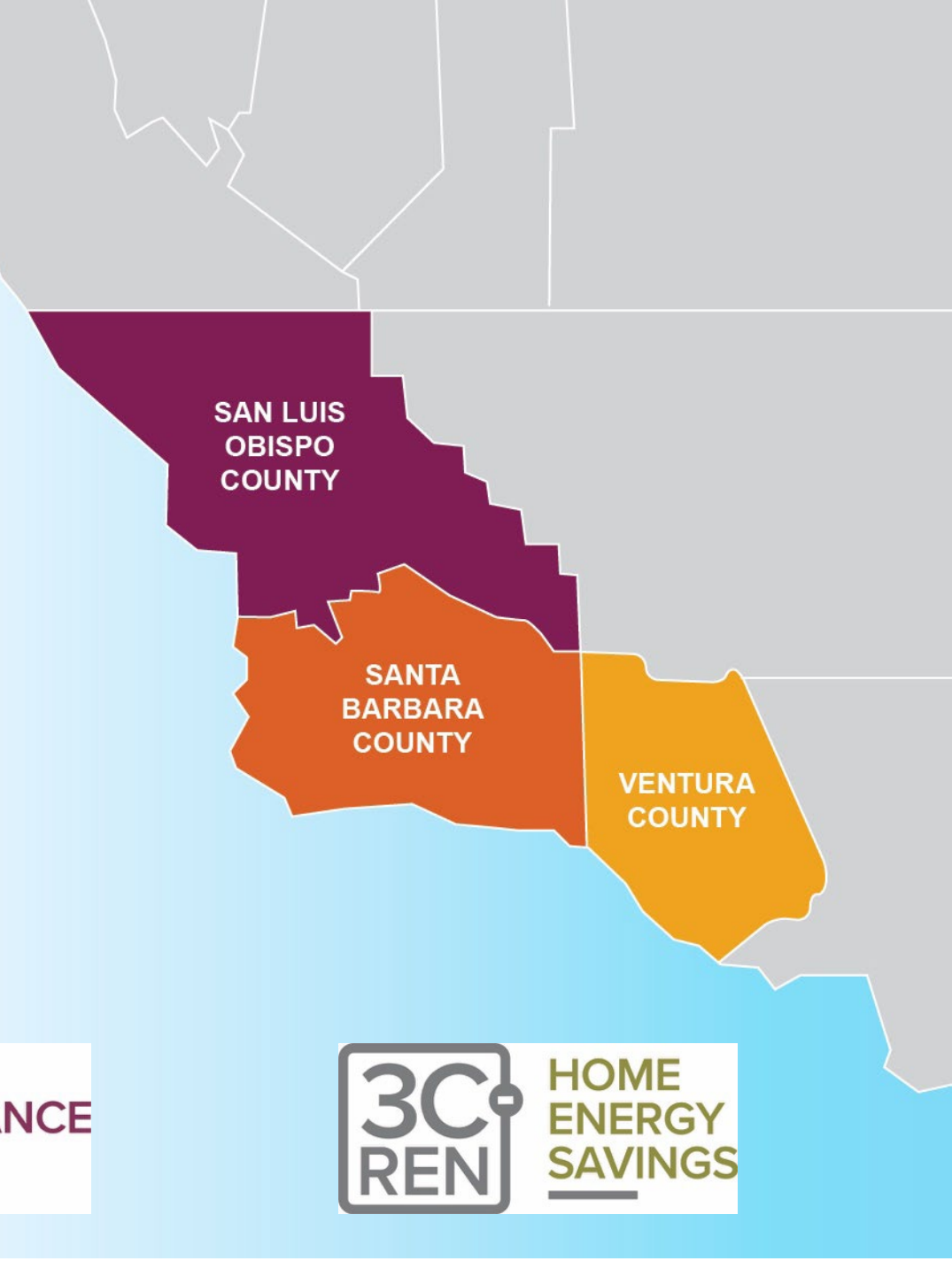
Using LCA & Embodied Carbon Calculators to Make Design and Product Choices

Vaclav Hasik – Building Transparency

January 18, 2024

3C-REN: Tri-County Regional Energy Network

- Three counties working together to improve energy efficiency in the region
- Services for –
  - **Building Professionals:** industry events, training, and energy code compliance support
  - **Households:** free and discounted home upgrades
- Funded by ratepayer dollars that 3C-REN returns to the region



3C REN ENERGY CODE CONNECT

3C REN BUILDING PERFORMANCE TRAINING

3C REN HOME ENERGY SAVINGS

3C-REN Programs

- Energy Code Connect (ECC)
  - Industry Trainings and Regional Forums
  - Energy Code Coach: Title 24 Compliance Support Hotline (805) 220-9991
- Building Performance Training (BPT)
  - Industry Trainings & Certification for current and perspective building professionals
  - Helps workers thrive in an evolving industry
- Home Energy Savings (HES)
  - Flexible Home Energy Upgrades
  - Multifamily (5+ units) & Single Family (up to 4 units)

3C-REN

Using LCA & Embodied Carbon Calculators to Make Design and Product Choices

Vaclav Hasik, PhD | Program Director
buildingtransparency.org

Building Transparency

Washington State 501c(3) nonprofit dedicated to sustainability in construction.

Building Transparency's core mission is to provide open access data and tools necessary to enable **broad and swift action** across the building industry in addressing embodied carbon's role in **climate change**.

EC3 tallyCAT tally

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One Click LCA TANGIBLE Ecomedes Mindful Materials Sustainable Minds

Incubation 2018-2019

Carbon Leadership Forum, Charles Pankow Foundation, MKA, Interface, Skanska USA, C-Change Labs, and over 50 industry partners

Development

cchange labs

Course Description

This hands-on, one-hour training will equip participants with the **practical knowledge and skills** to leverage Life Cycle Assessment (LCA) tools and embodied carbon (EC) calculators in the **architectural design and construction** process. The course will guide attendees through **each phase of a project**, from conceptual design to the as-built stage, highlighting the application and benefits of different LCA tools like **EPIC, Tally, and EC3**. In response to current market needs, this training also includes an overview of other popular LCA tools, their costs and capabilities, and the situations in which they are most effective. Participants will learn how to **utilize these tools** to make informed design decisions, foster constructive **conversations within the project** team, and track the project's embodied carbon footprint. Furthermore, we will explore **strategies for incentivizing low-carbon procurement** and identifying opportunities for future improvement. The objective is to empower participants to effectively integrate LCA and EC considerations into their projects, fostering a more sustainable and carbon-conscious built environment.

Learning Objectives

- Learn how to use EC/LCA tools effectively at each phase of design and construction
- Learn how to communicate across the design and construction team about EC/LCA topics
- Understand what decisions at each phase can lead to lower EC footprint
- Be able to track, look back, and learn from challenges in addressing EC

Agenda

1. Intro to Life Cycle Assessment (LCA)

Agenda

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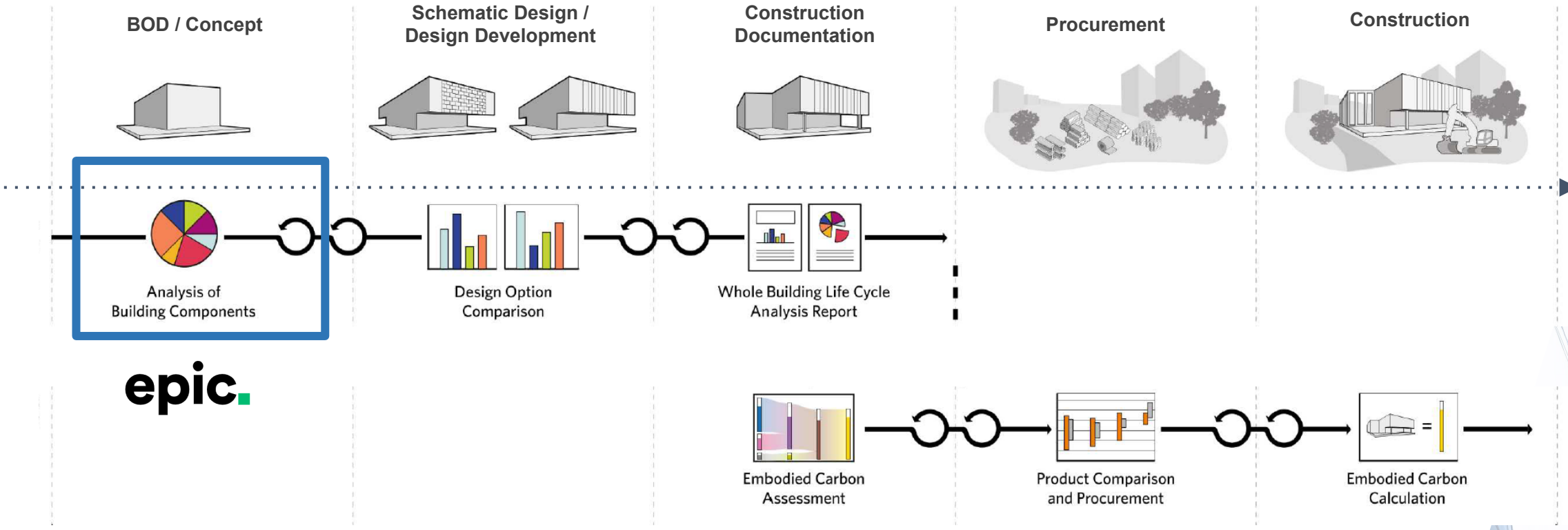
2. Planning

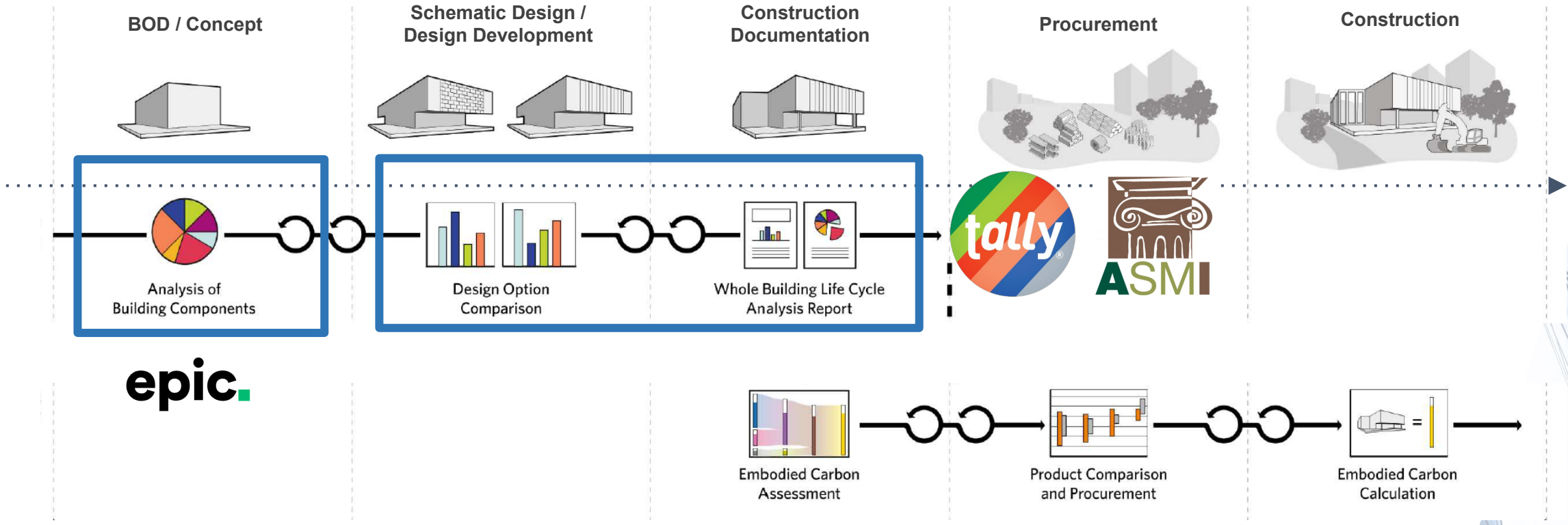


epic.

New vs retrofit. Shape and size. Location. → System X vs System Y → Product X vs Product Y → Bidding → Tracking

Agenda

1. Intro to Life Cycle Assessment (LCA)
2. Planning
3. Design



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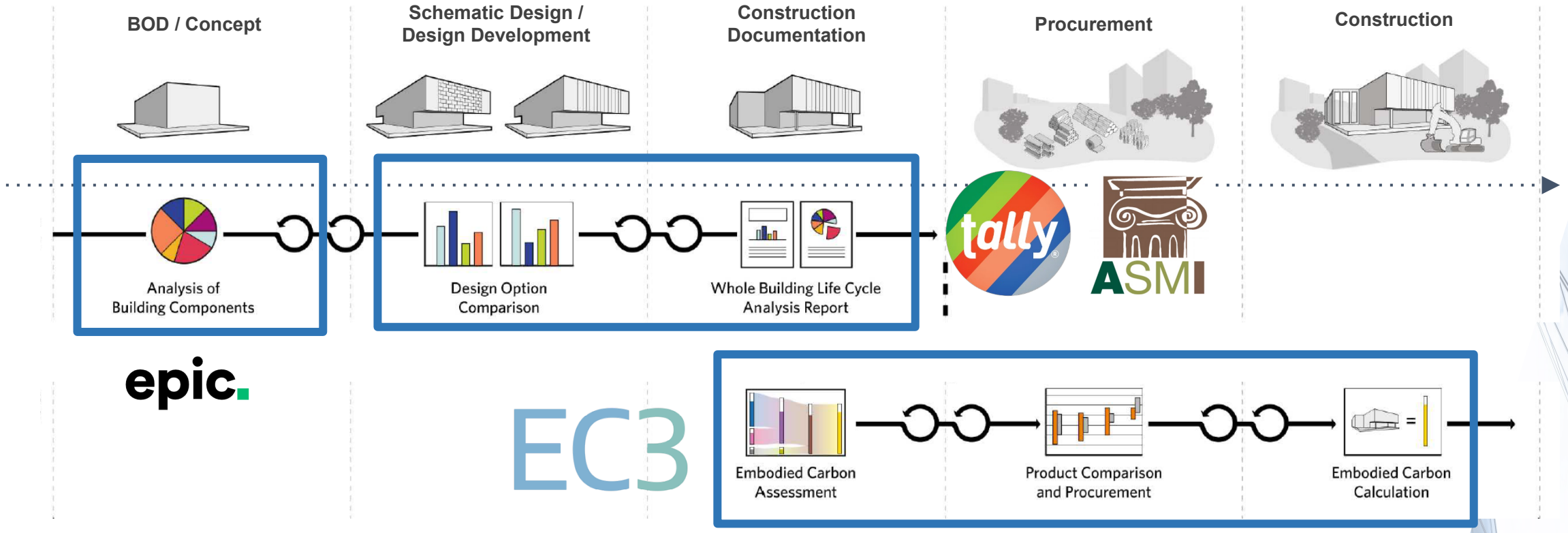

New vs retrofit. Shape and size. Location. → System X vs System Y → Product X vs Product Y → Bidding → Tracking

Evolution of the Ecosystem of Tools

1. INTRO TO LCA

LCA = Life Cycle Assessment

Approach for quantifying the environmental impacts of products and processes.

WBLCA = Whole Building Life Cycle Assessment

Approach for quantifying the environmental impacts of buildings.

EPD = Environmental Product Declaration

Results of an LCA for a single product or group of products.

GWP = Global Warming Potential

Impact category accounting for the effects of greenhouse gas emissions.

Product Impacts

Declared Unit: 1 m^3 of 10,000 psi concrete at 28 days

Amount Per Declared Unit	
Global Warming Potential	445 $kgCO_2eq$
Emitted	460 $kgCO_2eq$
Sequestered	-15 $kgCO_2eq$
Ozone Depletion	0.000 kgCFC11eq
Acidification	2.96 $kgSO_2eq$
Eutrophication	0.09 kgNeq
Smog Formation	0.61 kgO_3eq
Primary Energy Demand	3017 MJ
Non-renewable	3000 MJ
Renewable	17 MJ

**For illustration only. Values shown above may not represent a real product.*

What is embodied carbon?

LCA = Life Cycle Assessment

Systematic analysis of environmental impacts of products by accounting for resource consumption, emissions, and wastes throughout their life cycle.

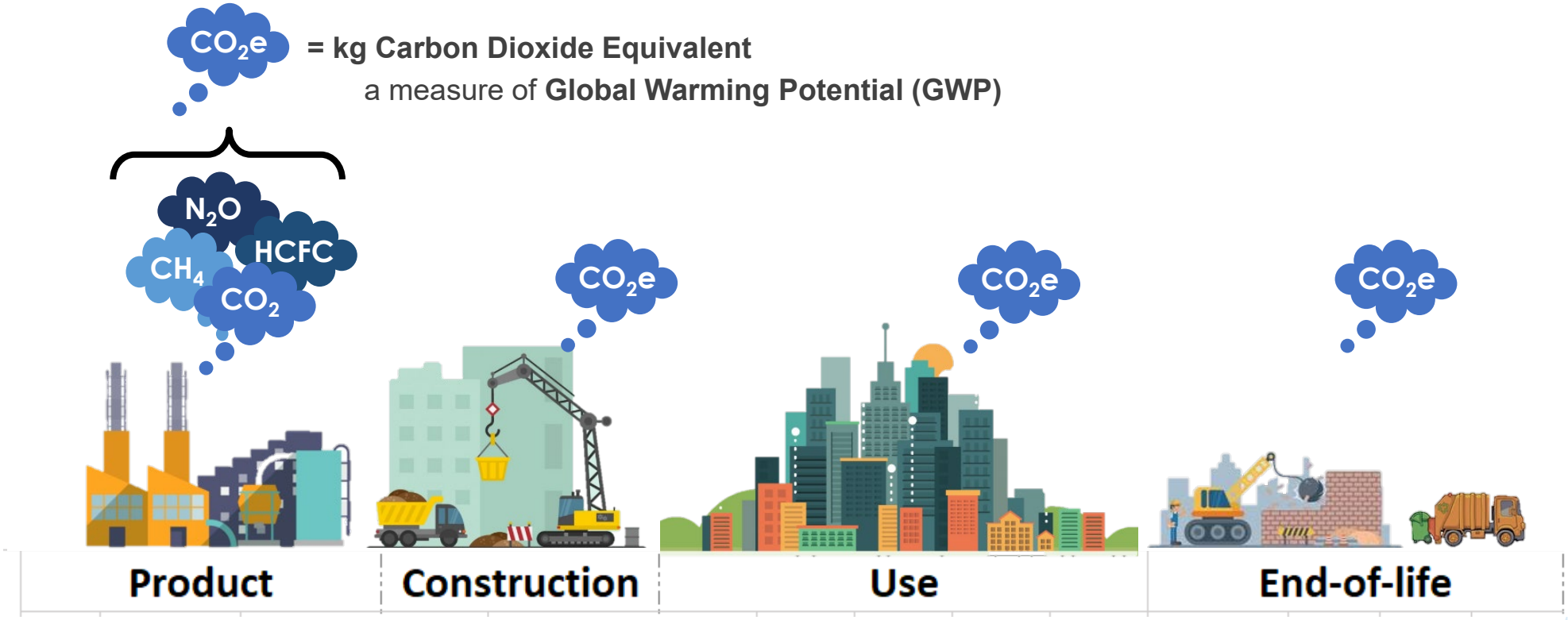

Photo by Vlad Chetan: https://www.pexels.com/photo/mining-excavation-on-a-mountain-2892618/

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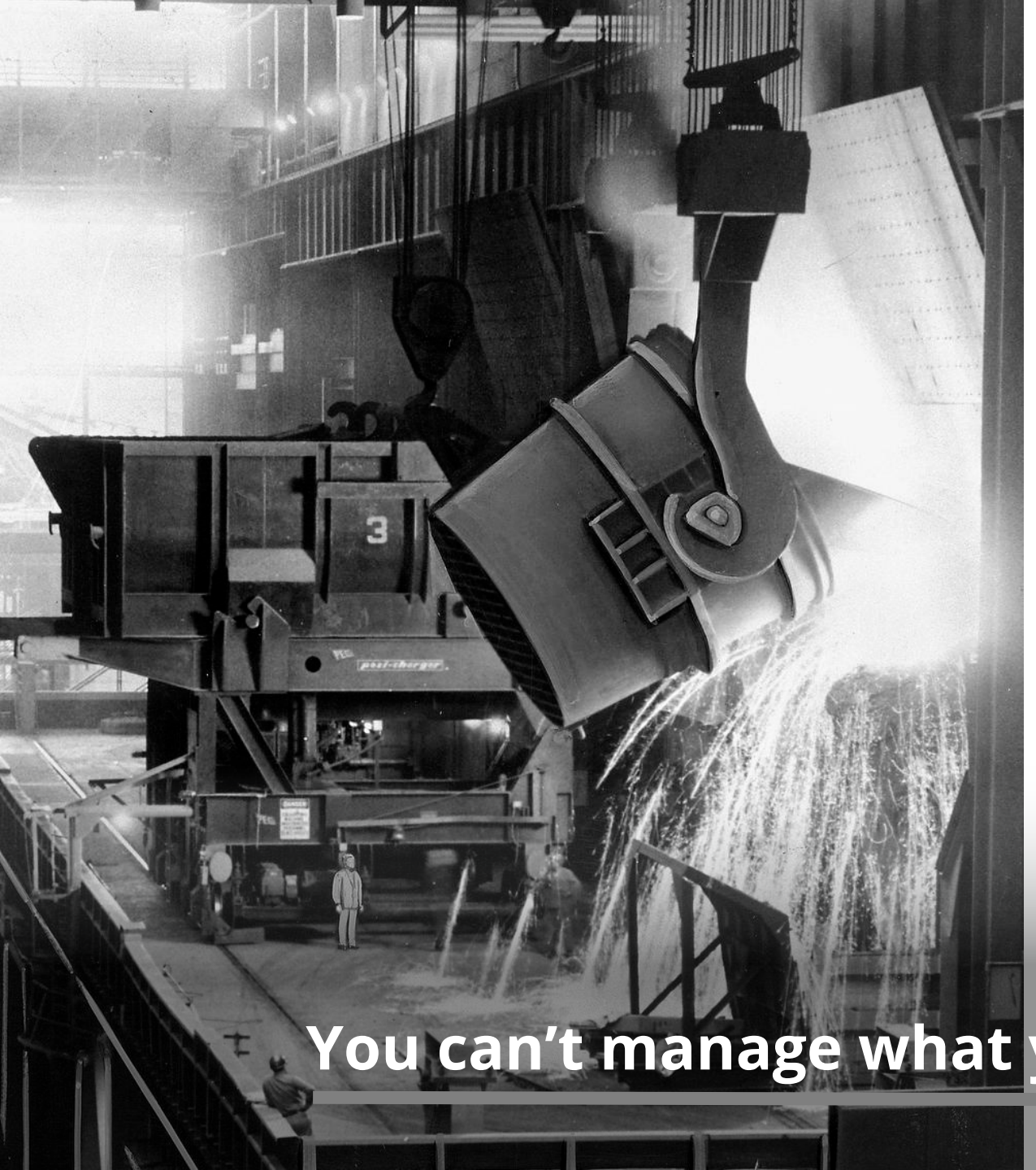


You can’t manage what you don’t measure.

Building Life Cycle Assessment (LCA)

It's simple

Quantity × Impact Factor

1 CY of concrete × 389 $kgCO_2e$/CY of concrete

- Design
- Takeoffs
- Scope

- Carbon Data
- Tools

epic.

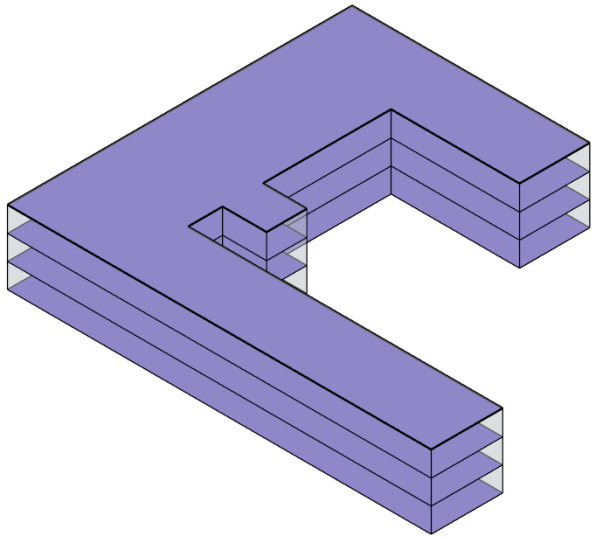
ASMI

tally

EC3

2. PLANNING

epic.



3C-REN School

Up to Date

K-12 School | 54,000 sf | 2024 completion

Refine Scope

Project Base Case

Project Name *
3C-REN School

Project Description
Demo project for 3C-REN.

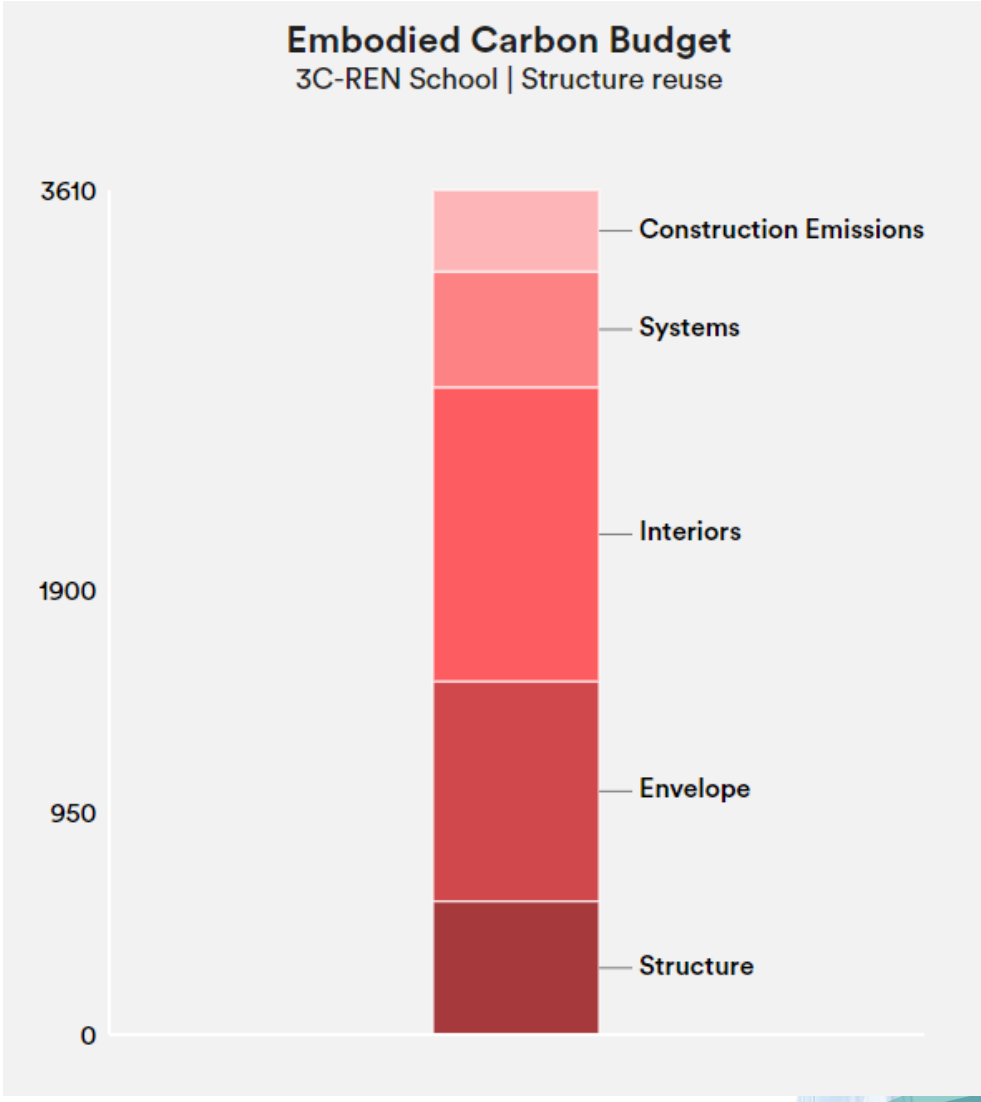
Year of Project Completion *
2024
Year of substantial completion

Country *
USA

Location *
94607
Postal code

Baseline Structural System *
Reinforced Concrete
Project's baseline structural system

Primary Use *

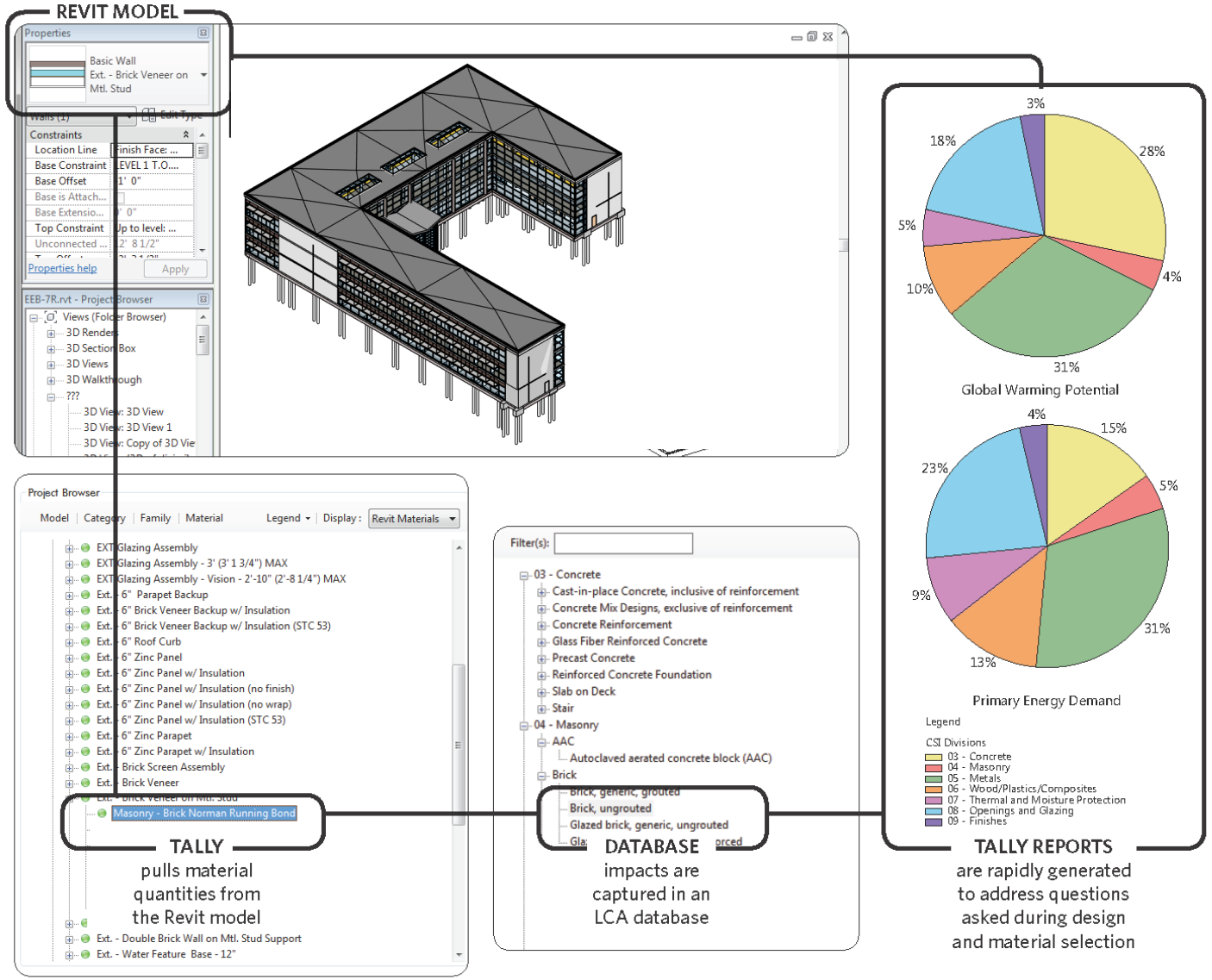


Project information

Project name	3C-REN School	
Project location	Oakland, CA	
Project use type	Education	
Gross floor area	5,010 m2	54,000 ft2
Expected building life	60 years	
Stories	3	
Area per floor	1,670 m2	18,000 ft2

Tool walkthrough

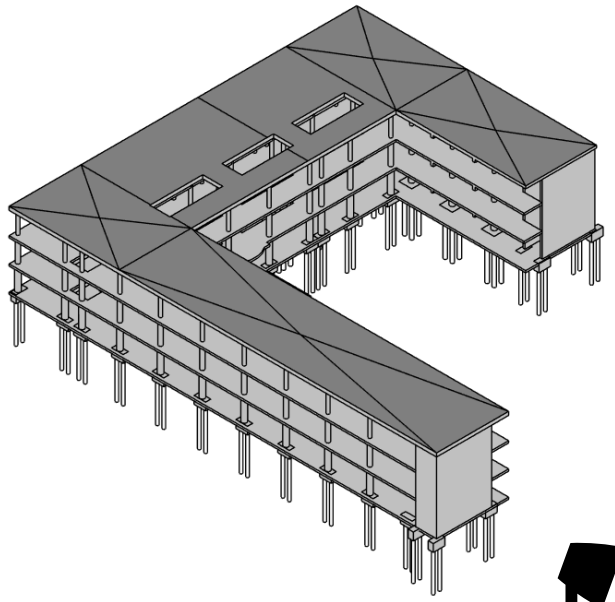
3. DESIGN

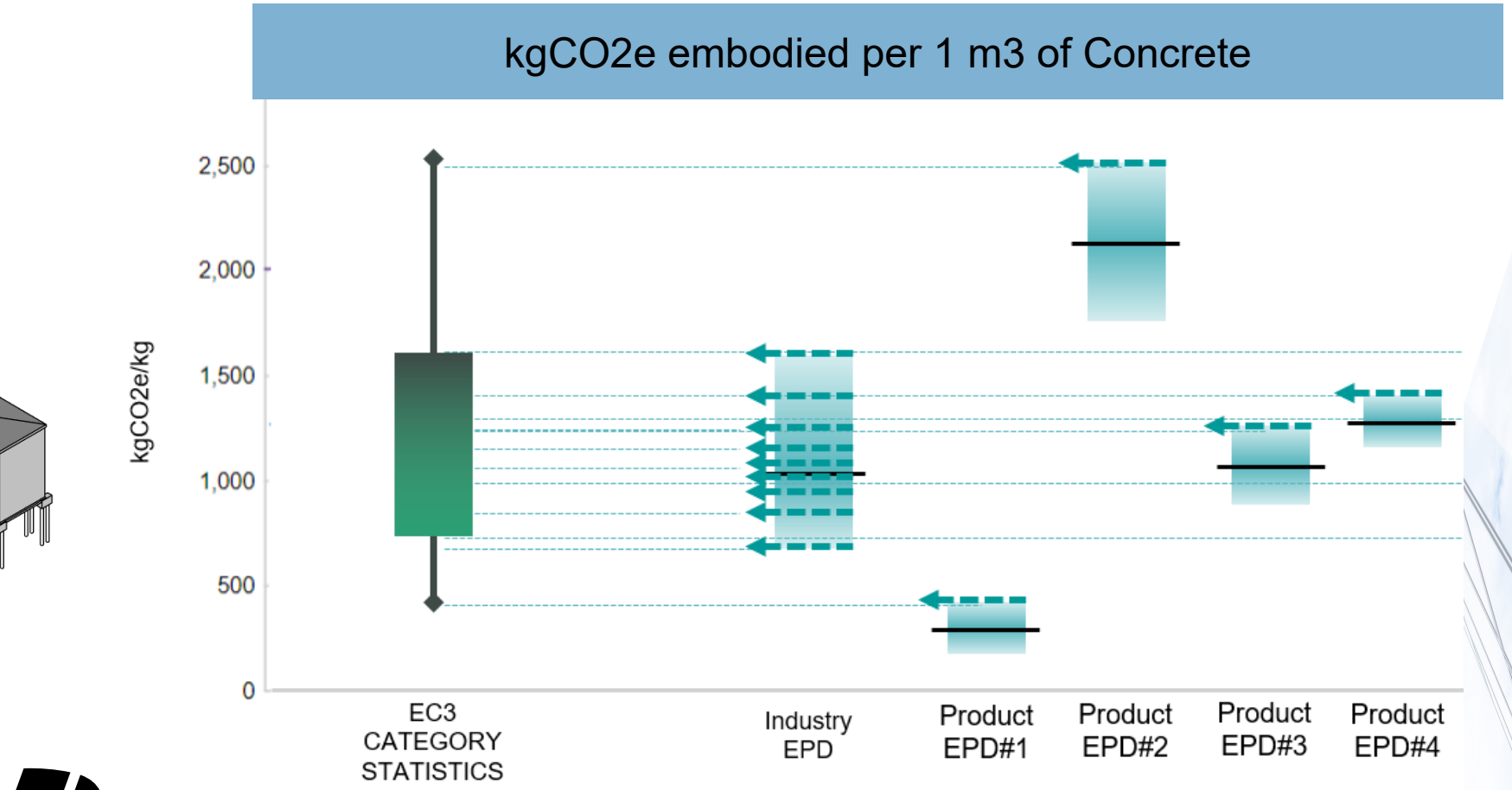


Tool walkthrough

4. CONSTRUCTION

EC3





Tool walkthrough

Specification Documents

Add language requiring submission of EPDs

SECTION 03 30 00 – CAST-IN-PLACE CONCRETE

SUBMITTALS (added language)

A. Environmental Product Declaration (EPD): Submit in accordance with the Specification Section for LEED Submittals, Section 013510.01.B.1– Environmental Product Declarations.

1. Submit a product-specific EPD for 90% by volume for all concrete mixes used in the project in the "Concrete Mix Specification Table" within the Concrete section of the structural general notes.

2. Impact Categories:

   a. Global Warming Potential (GWP): All GWP information submitted shall be in the form of $kgCO_2eq/kg$.
   b. Ozone Depletion Potential (ODP): All ODP information submitted shall be in the form of kgCFC-11/kg.
   c. Acidification Potential (AP): All AP information submitted shall be in the form of $kgSO_2/kg$.
   d. Eutrophication Potential (EP): All EP information submitted shall be in the form of kg N/kg.
   e. Smog Formation Potential (SFP): All SFP information submitted shall be in the form of kgO_3/kg.
   f. Non-Renewable Energy Consumption (NREC): All NREC information submitted shall be in the form of MJ.

buildingtransparency.org/resources/ec3-downloads/

Specification Documents

Add language requiring submission of Bill of Materials

C. Bill of Materials: Material supplier(s) shall provide a report to the General Contractor, at the completion of 100% Construction Documents, or as soon thereafter when the material sources are known, and at the completion of the primary structural frame, summarizing all concrete quantities and the location where each material was obtained. Each unique mix design used on the project shall be itemized.

1. In addition to the requirements above, report the following in cubic yards for concrete and itemize as required for each unique mix design:

   a. Total Concrete Volume

   NOTE TO ENGINEER: Italicized items below are not required for LEED v4. Consider including only if will not adversely affect cost.

   b. Concrete Volume used in Foundations
   c. Concrete Volume used in Horizontal Applications, e.g. Slabs/Beams
   d. Concrete Volume used in Vertical Applications, e.g. Walls/Columns

buildingtransparency.org/resources/ec3-downloads/

Specification Documents

Performance-based specifications

Examples of text for list of concrete mixtures under Concrete Mixtures section of specifications or General Notes:

Y. Type A – Foundation: Footings, Grade Beams, Pile Caps
- Normal weight concrete
- Strength - f'c = 4000 psi (at 90 days)
- Exposure class: F0, S1, C0, W0
- Maximum Embodied Carbon = **[Insert limit here]** kg-CO2e/m3

Z. Type B – Walls, Columns, Beams, Topping Slabs
- Normal weight concrete
- Strength - f'c = 6000 psi (at 56 days)
- Exposure class: F0, S0, C0, W1
- Shrinkage limit = 0.040%
- Maximum Embodied Carbon= [**Insert limit here]** kg-CO2e/m3

marincounty.org/depts/cd/divisions/sustainability/low-carbon-concrete

https://www.nrmca.org/wp-content/uploads/2020/10/GuideToSpecs.pdf

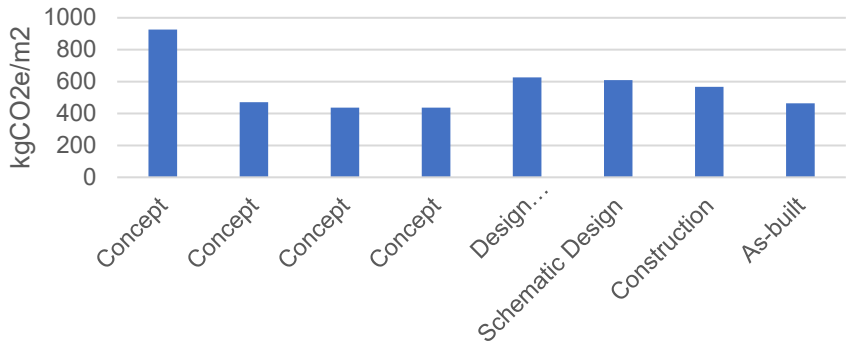
Summary

Results of the case study building

Tool	Phase	GWP	GWP Net	Units	Included Life Cycle Stages*	Included Systems*	Description of change from previous result
EPIC	Concept	926		kgCO2e/m2	A-C	All	Initial pre-design estimate
EPIC	Concept	470		kgCO2e/m2	A1-A5	Envelope, Structure	Initial pre-design estimate
EPIC	Concept	437		kgCO2e/m2	A1-A5	Envelope, Structure	Mass timber frame
EPIC	Concept	437	285	kgCO2e/m2	A1-A5	Envelope, Structure	Mass timber frame with FSC wood
tallyLCA	Design Development	627		kgCO2e/m2	A1-A3	Envelope, Structure	Initial detailed design
tallyLCA	Schematic Design	609		kgCO2e/m2	A1-A3	Envelope, Structure	Optimized roof design with Steel Joist, EPS, and TPO
EC3	Construction	567		kgCO2e/m2	A1-A3	Envelope, Structure	Initial product-specific analysis
EC3	As-built	464		kgCO2e/m2	A1-A3	Envelope, Structure	Low-carbon concrete mixes, specific rebar supplier

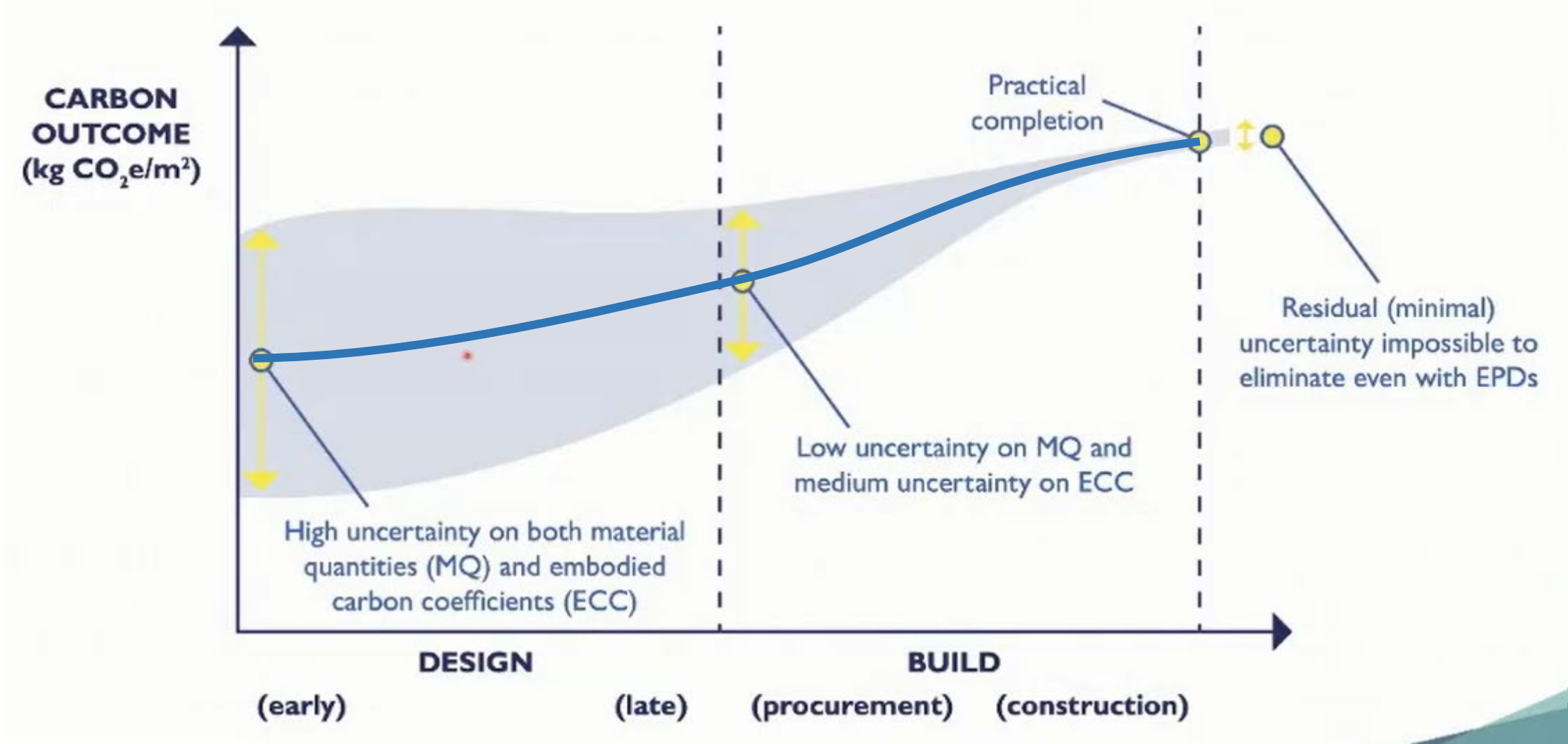
* Results for different scopes are shown as a demonstration only. You only want to align the scope of various assessments, if you are comparing them.

GWP Net includes credit for carbon that is sequestered by biobased materials like mass timber and stored in the material for the life of the building. Note that this credit is contingent on sustainable sourcing and the stored carbon may be re-emitted into the atmosphere under certain disposal scenarios.



Uncertainty

MQ x ECC



What can you do to lower the impact of your project?

1. Reuse buildings
2. Reuse products
3. Optimize design
4. Choose materials
5. Choose products
6. Specify disclosure & tracking

Planning (Concept)

- EPIC
- Goal setting
- Basis of Design

Design (DD, SD, CD)

- tallyLCA / Athena / BEAM / Kaleidoscope
- System-level decisions

Construction (CD, Bid, As-Built)

- EC3
- Product-level decisions
- Specifications (performance, tracking, EPDs)
- Bidding

High-impact systems

- Structure
- Envelope
- Interiors (w/replacements)
- MEP (w/replacements)

High-impact materials

- Concrete, steel, aluminum, bricks, plastics
- Wood (depends on sourcing)

Low-carbon options

- Natural materials
- Specific products within the high-impact materials (ask for EPDs)

Thank you

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Resources

BuildingTransparency.org

- EC3 Video tutorials
- EC3 User Guide
- Sample bid documents

ChooseTally.com

- TallyLCA Video tutorials

CarbonLeadershipForum.org

- Embodied Carbon Toolkit

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Closing

- Continuing Education Units Available
  - Contact <ian.logan@ventura.org> for AIA LUs
- Coming to Your Inbox Soon!
  - Slides & Survey – Please Take It and Help Us Out!
- Upcoming Events:
  - 1/24: Batteries - Options and Implementation for A Building's Energy Storage System
  - 1/30: Intro to Residential HVAC Systems
  - 1/31: Energy Code Compliance: Using HERS Measures
  - 2/8 Retaining Profit – Minimizing Call Backs on Heat Pump Installs
- For more information about upcoming events please visit: https://www.3c-ren.org/events

Thank you!

For more info:
3c-ren.org

For questions:
info@3c-ren.org

3C REN

TRI-COUNTY REGIONAL ENERGY NETWORK

SAN LUIS OBISPO • SANTA BARBARA • VENTURA