

2022

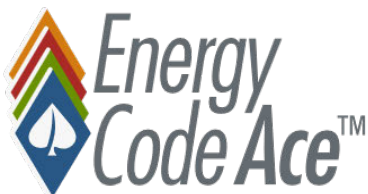
# CODE BREAKER

Embodied Carbon  
& CALGreen

Solving the Energy Code Puzzle One Piece at a Time

## Participant Handout

May 2024



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## LEGAL NOTICE

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## ABOUT THE STATEWIDE CODES AND STANDARDS PROGRAM

The Statewide Codes and Standards Program (C&S Program) is jointly managed by PG&E, SDG&E, and SCE. The C&S Program saves energy on behalf of ratepayers by directly influencing standards and code-setting bodies to strengthen energy efficiency regulations, by improving compliance with existing codes and standards, and working with local governments to develop ordinances that exceed statewide minimum requirements.

**This class is one of many free courses, tools, and resources that the C&S Program offers.**  
Please visit <http://energycodeace.com/> or contact [info@energycodeace.com](mailto:info@energycodeace.com) to find out more about all program offerings.



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# AIA Course Information

## **2022 Code Breaker: Embodied Carbon & CALGreen**

Learning Units: 1.0 AIA LU | HSW

### **Energy Code Ace**

Provider Number: 404109083

**AIA**  
Continuing  
Education  
Provider

## Course Description

July 2024 brings new CALGreen requirements for commercial buildings over 100,000 square feet and school buildings over 50,000 square feet to show embodied carbon savings. This short one-hour session will cover these new requirements, as well as explain the concepts, why embodied carbon matters, how to measure and reduce embodied carbon, and how to show compliance with the new CALGreen requirements via prescriptive and performance pathways.

## Course Objectives

- Differentiate between embodied carbon and operational carbon
- Describe the importance of managing embodied carbon in achieving California's climate goals
- Explain how to measure and reduce embodied carbon and support design decisions with the most significant impact
- Identify CALGreen requirements on embodied carbon that will take effect July 1, 2024

**AIA**  
**Continuing**  
**Education**  
**Provider**

Credit(s) earned on completion of this course will be reported to **AIA CES** for AIA members. Certificates of Completion for both AIA members and non-AIA members are available upon request.

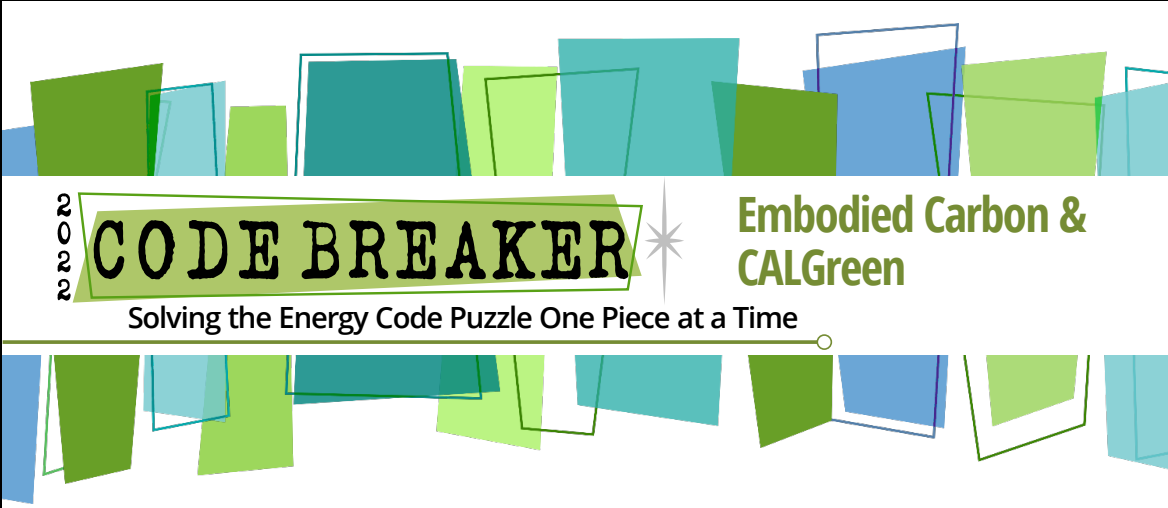
This course is registered with **AIA CES** for continuing professional education. As such, it does not include content that may be deemed or construed to be an approval or endorsement by the AIA of any material of construction or any method or manner of handling, using, distributing, or dealing in any material or product.

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Questions related to specific materials, methods, and services will be addressed at the conclusion of this presentation.

**AIA**  
**Continuing**  
**Education**  
**Provider**

# Welcome

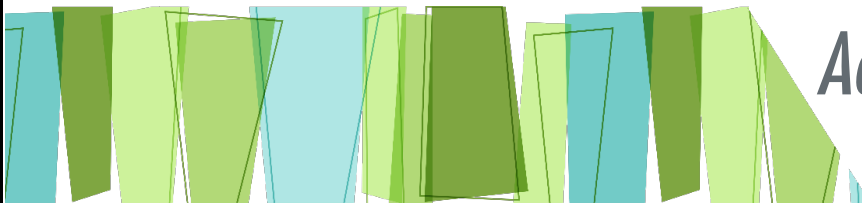


**2022** **CODE BREAKER** \* **Embodied Carbon & CALGreen**  
Solving the Energy Code Puzzle One Piece at a Time

Continuing Education Information	
AIA Provider ID: 40410982	AIA Course Number: 22 CB EC CALGrn
ICC Provider ID: 1534	ICC Course Number: 40033

# Documenting Continuing Education Units (CEUs)

- ✦ Attendees who meet the completion criteria receive “standard” certificates of completion:
  - ✦ Typically sent within two weeks of course delivery
  - ✦ Certificate includes:
    - ◆ Course IDs (AIA & ICC)
    - ◆ Energy Code Ace Provider info (AIA & ICC)
- ✦ You may use this certificate to “self-certify” with a number of organizations in addition to AIA & ICC
  - ✦ If you entered your AIA member number when you registered, we will submit your course-completion information to AIA for you



Ace Training™

## Training Objectives:

- Differentiate between embodied carbon and operational carbon
- Describe the importance of managing embodied carbon in achieving California’s climate goals
- Explain how to measure and reduce embodied carbon and support design decisions with the most significant impact
- Identify CALGreen requirements on embodied carbon that will take effect July 1, 2024







Your one-stop shop for no-cost tools, training and resources to help you comply with California's Title 24, Part 6 building energy code and Title 20 appliance standards.

We're powered by the California Statewide Codes & Standards Program and vetted by the California Energy Commission.



A suite of interactive tools to help you understand the compliance process, required forms, installation techniques and energy efficiency regulations applicable to building projects and appliances in California

**Our Tools include:**

- + Energy Code Product Finder
- + Forms Ace
- + Image Ace
- + Navigator Ace
- + Nonres. Indoor Lighting Wheel
- + Q&Ace
- + Reference Ace
- + Timeline Ace
- + Virtual Compliance Assistant

**EnergyCodeAce™**  
Comply With Me™

## Ace\*Tools™



## TRAINING

Comply With Me  
EnergyCodeAce.com

## Ace\*Resources™

A portfolio of on-demand and live online and in-person training alternatives on California's Energy Code and Title 20 regulations, tailored to a variety of industry professionals and addressing key measures

**Our Training includes a variety of formats:**

- ✦ In-person instructor-led
- ✦ Online instructor-led
- ✦ Online self-study
- ✦ Recorded webinars
- ✦ YouTube — live streaming & videos

**EnergyCodeAce™**  
Comply With Me™

## Ace\*Tools™

## Ace\*Training™



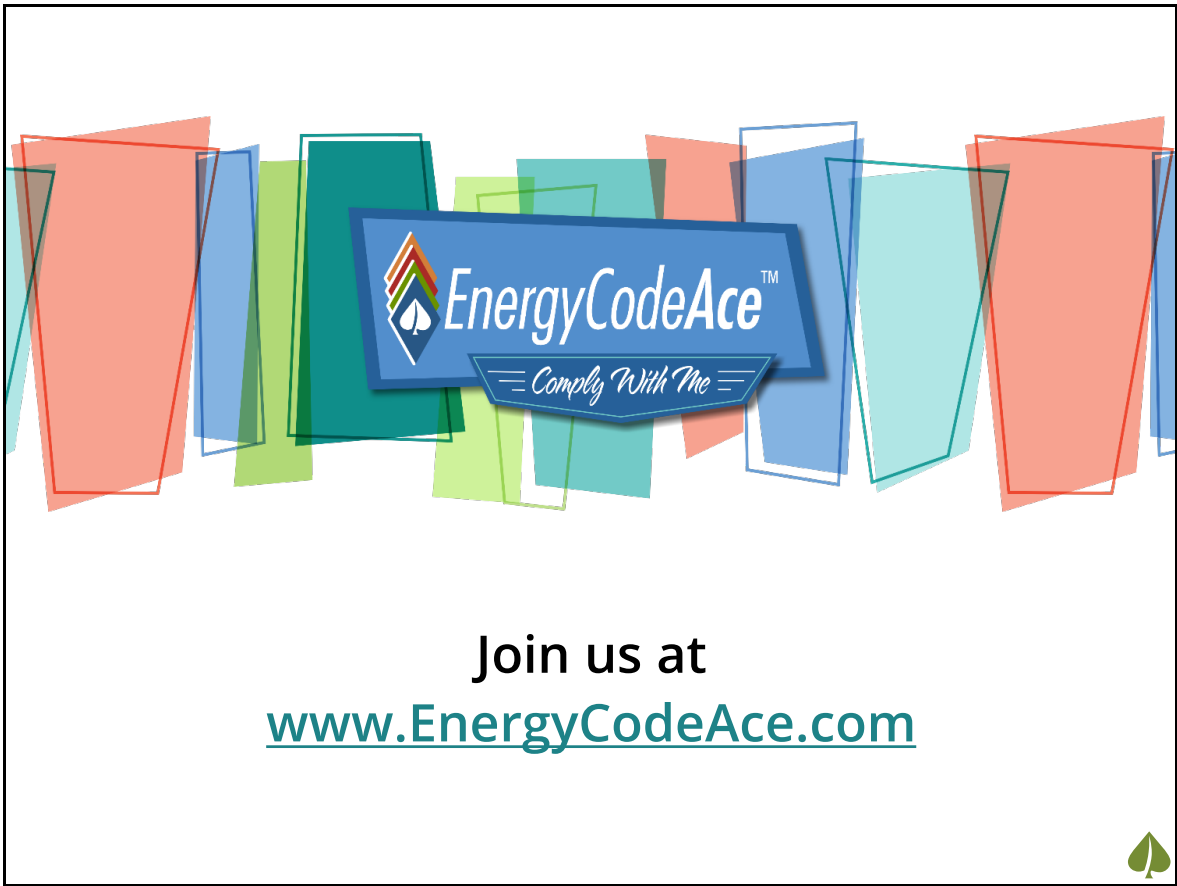
## RESOURCES

Comply With Me  
EnergyCodeAce.com

An array of downloadable materials providing practical and concise guidance on how and when to comply with California's building and appliance energy efficiency standards

**Our Resources include:**

- ✦ Application Guides
- ✦ Checklists
- ✦ Fact Sheets
- ✦ Submit a Question
- ✦ Trigger Sheets
- ✦ Useful Links



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# What is Embodied Carbon?

## 2022 Code Breaker: Embodied Carbon & CALGreen

### 1. What is Embodied Carbon?

2. Why Care About Embodied Carbon?
3. Measuring & Reducing Embodied Carbon
4. CALGreen Embodied Carbon Requirements
5. Next Steps

- ✦ Zero Net Carbon Design
- ✦ Embodied Carbon
- ✦ Operational Carbon
- ✦ Whole Life Carbon

## Recent Changes Require Attention to Embodied Carbon

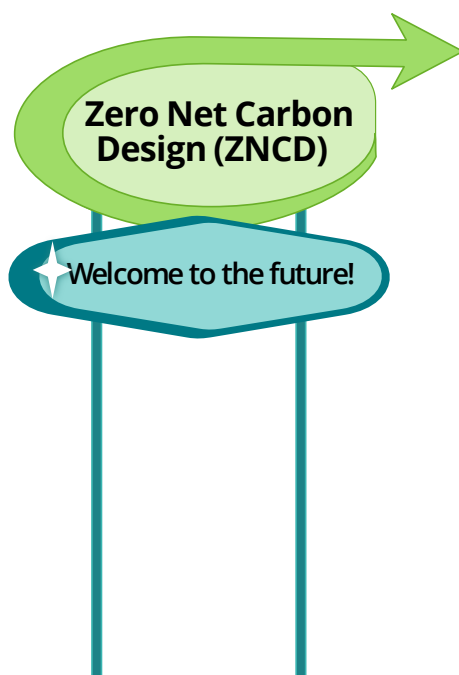


**Embodied Carbon is the sum of CO<sub>2</sub> emissions from every aspect of a building's lifecycle except its operation.**

- ✦ **AB 2446 (Carbon Intensity of Construction and Building Materials Act)** requires the Air Resources Board to develop a framework measuring and reducing the average carbon intensity of building materials to achieve 40% GHG net reduction by 2035.
  - ◇ Phased implementation must eventually include life cycle assessment for new nonresidential buildings >10,000 ft<sup>2</sup> and new residential buildings with 5 or more dwelling units;
  - ◇ Must include requirements for manufacturers of building materials to submit Environmental Product Declarations.
- ✦ **Embodied Carbon – CALGreen 2022** Intervening Code Adoption Cycle (effective July 1, 2024) is how the state is meeting AB 2446 requirements



## Zero Net Carbon Design (ZNCD)



**ZNCD represents a highly energy-efficient building that produces onsite—or procures—enough carbon-free renewable energy to meet annual energy consumption.**

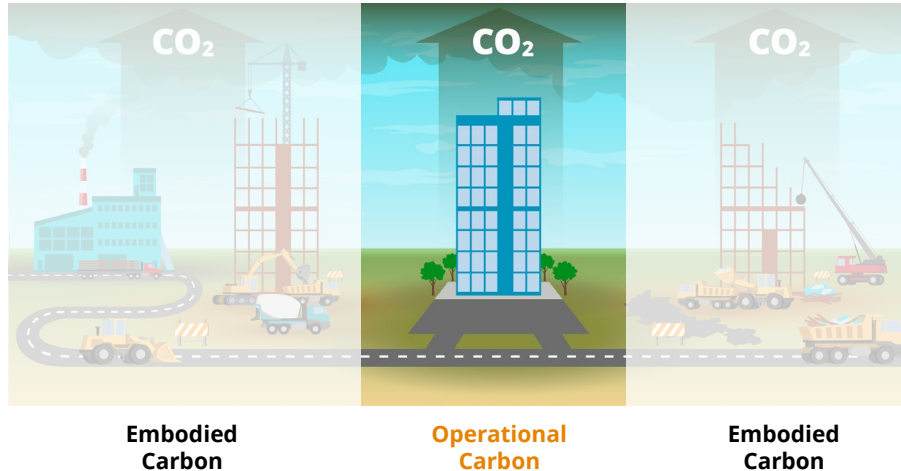
### California Policy Supporting ZNCD

- ✦ **California licensed architects** required to attend ZNCD CEU courses
- ✦ **Electrification measures** of the 2022 Energy Code reduce Carbon emissions of buildings
- ✦ **Renewable requirements** of the 2022 Energy Code require PV systems on all new residential and commercial buildings
  - ◇ **Battery storage** also required by the 2022 Energy Code on new commercial and high-rise multifamily buildings



# Operational Carbon

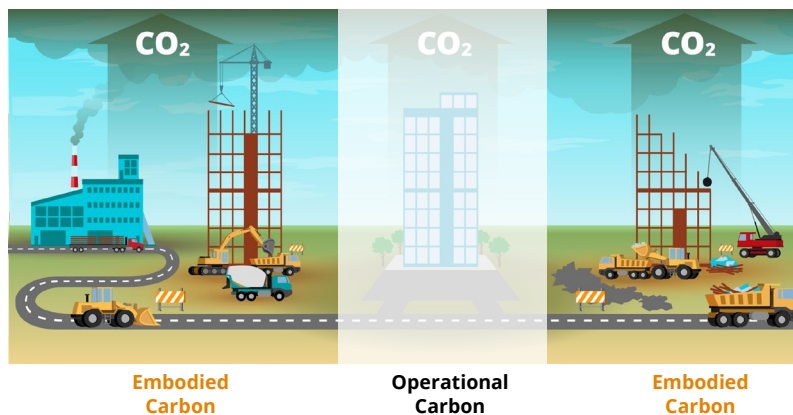
Operational carbon is CO<sub>2</sub> emissions associated with *using* the building, including emissions from energy used for (but not limited to) heating, cooling, ventilation, domestic hot water, lighting and plug loads.



# Embodied Carbon

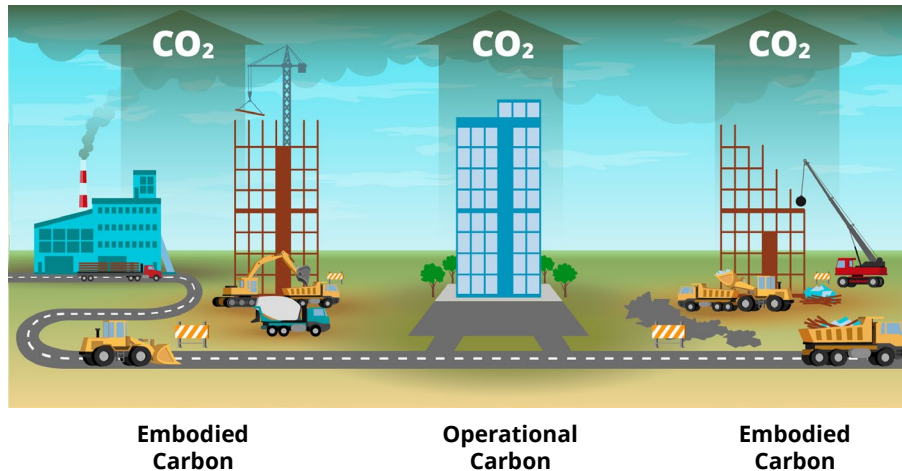
Embodied carbon is the sum of CO<sub>2</sub> emissions from every aspect of a building's lifecycle *except* its operation:

- ✦ Raw material extraction for the building materials (for example, mining)
- ✦ Manufacturing of the building materials
- ✦ Transportation of the building materials to the building site
- ✦ Demolition and disposal of the building at its end of life



# Whole Life Carbon = Operational + Embodied Carbon

Whole life carbon is the total CO<sub>2</sub> emissions during a building's entire lifecycle, including embodied carbon and operational carbon.



## Check Your Understanding

### What do you think?

Which of the following will impact a building's **embodied** carbon?  
[Select all that apply]

- a) Manufacturing of the building materials
- b) Heating and cooling energy use
- c) Plug loads energy use
- d) Demolition and disposal of the building at its end of life





# Why Care About Embodied Carbon?

## 2022 Code Breaker: Embodied Carbon & CALGreen

1. What is Embodied Carbon?

**2. Why Care About Embodied Carbon?**

3. Measuring & Reducing Embodied Carbon

4. CALGreen Embodied Carbon Requirements

5. Next Steps

- ✦ Carbon Emissions & Global Temperatures
- ✦ Relative Magnitudes of Operational and Embodied Carbon
- ✦ The Next Decade is Critical
- ✦ Design Decisions with Biggest Impact on Embodied Carbon

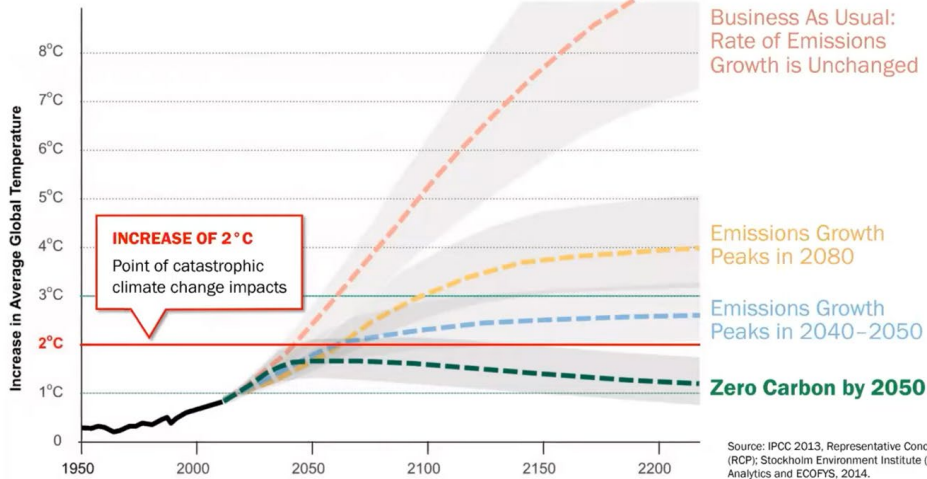


# Carbon Emissions Effect on Global Temperature

## To Avoid Unpredictable Effects of Temperature Rise:

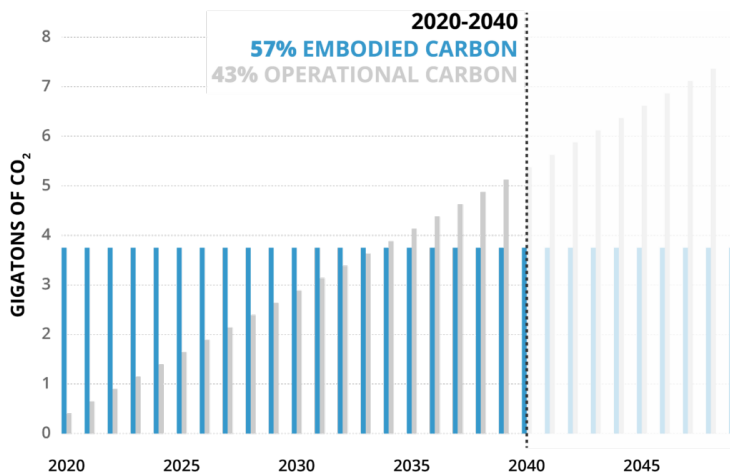
- ✦ Carbon emissions must come down
- ✦ Carbon emissions must reach **Zero** by **2050**
- ✦ Slower action will lead to much higher global temperatures

IPCC Global Temperature Projection Scenarios



# What's More Important: Operational or Embodied?

Total Carbon Emissions of **Global New Construction**  
with no building sector interventions



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Data Sources: UN Environment Global Status Report 2017; EIA International Energy Outlook 2017

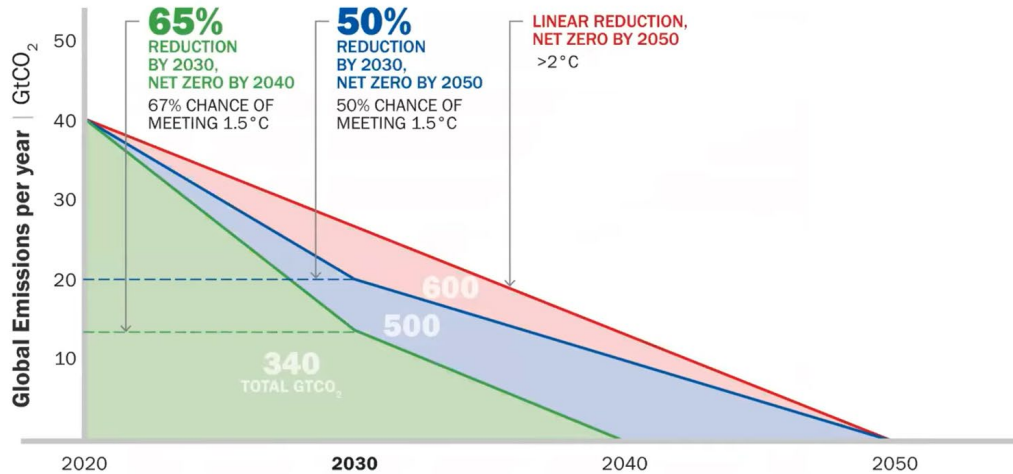
## They Both Contribute Similar Amounts of Carbon Emissions over 20 Years

- ✦ Each year, new buildings add **EMBODIED** Carbon to the environment
- ✦ Those buildings add **OPERATIONAL** Carbon to the environment every year
- ✦ The cumulative total Carbon emissions over 20 years is\*:
  - ◇ 57% embodied
  - ◇ 43% operational

\*figures are typical and will vary by project

# The Next Decade is Critical

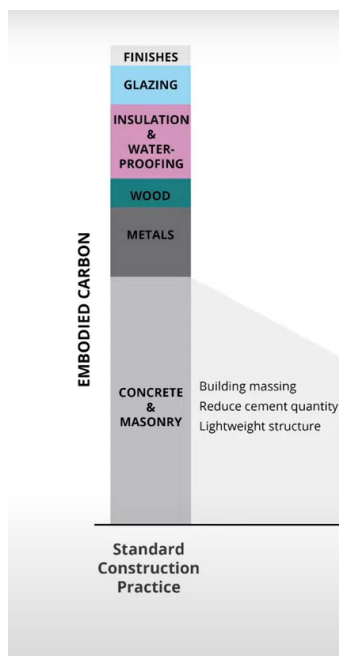
If we can bend the curve more steeply in the next decade, we can add less Carbon and will be more likely to meet 1.5° C target



© GOODY CLANCY  
DATA SOURCE: ARCHITECTURE 2030

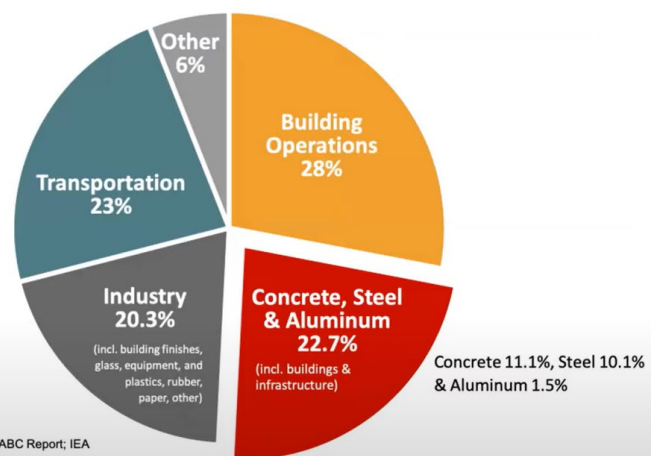


# Design Decisions With Biggest Impact on Embodied Carbon



Source: Kieran Timberlake

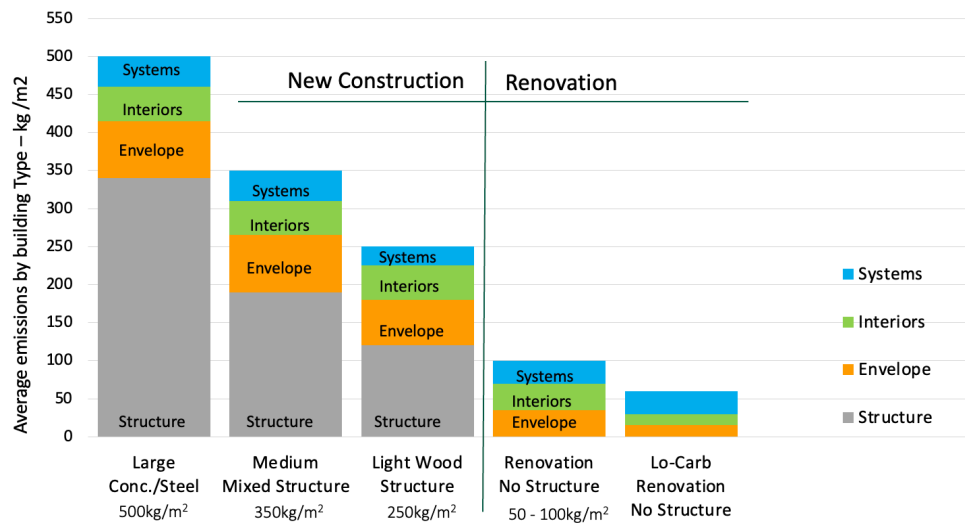
## Global CO<sub>2</sub> Emissions by Sector



Source: 2018 Global ABC Report; IEA



# Adaptive Reuse is the first option for Existing Buildings



Source: Embodied Carbon Benchmark Project, Carbon Leadership Forum and multiple embodied energy and carbon studies, courtesy of Larry Strain



## Check Your Understanding

### What do you think?

What design decisions typically have the biggest impact on embodied carbon of buildings.

[Select all that apply]

- a) Appliances
- b) Concrete and steel
- c) HVAC systems
- d) Water heating systems



# Measuring & Reducing Embodied Carbon

## 2022 Code Breaker: Embodied Carbon & CALGreen

1. What is Embodied Carbon?

2. Why Care About Embodied Carbon?

**3. Measuring & Reducing Embodied Carbon**

4. CALGreen Embodied Carbon Requirements

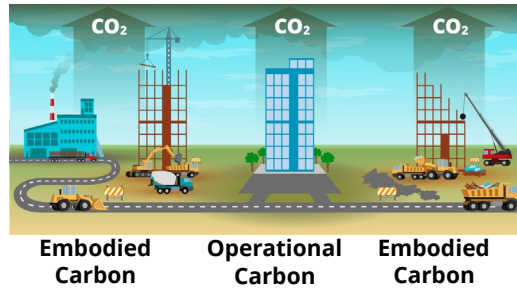
5. Next Steps

- ✦ How to Measure Embodied Carbon
- ✦ How to Reduce Embodied Carbon
- ✦ Don't Forget Operational Carbon!



## How to Measure Embodied Carbon

**Life Cycle Assessment (LCA)** is a method to measure environmental impacts of:



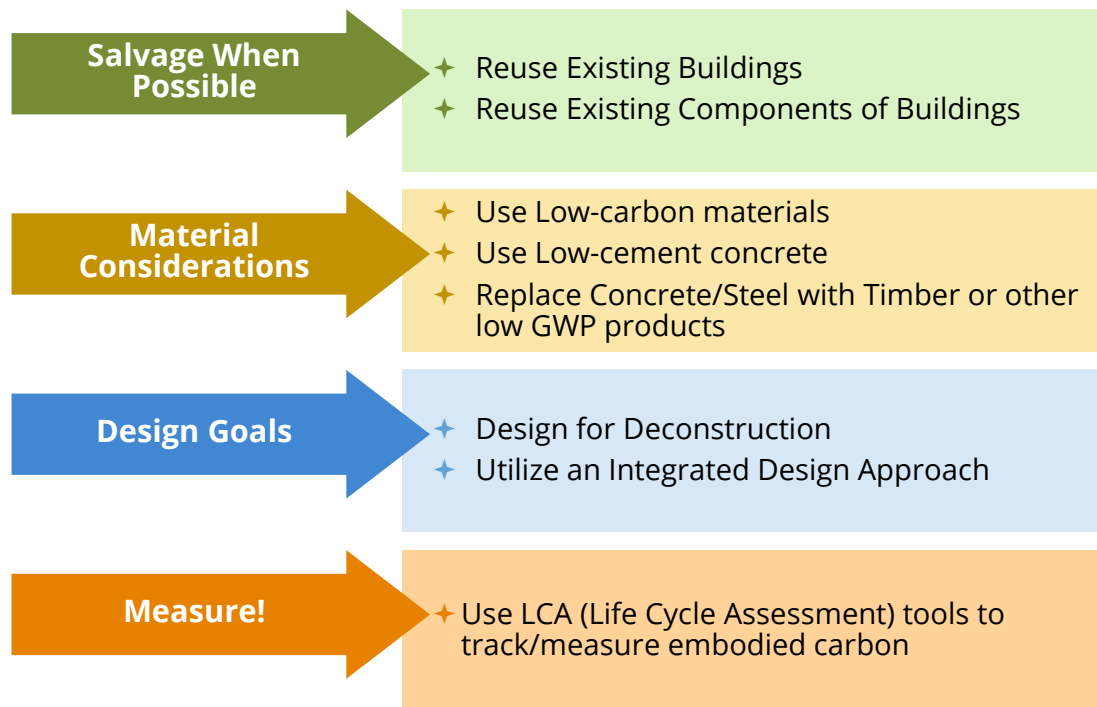
*Equation: Quantity of Material × Environmental Impacts of the Material = Embodied Carbon Global Warming Potential (GWP)*

- Example: 100kg steel × 0.43 GWP/kg = 43kg LCA GWP

- ✦ **Recommended approach:** Utilize an **integrated design approach** incorporating LCA in support of project's ZNCD goals for embodied carbon.
- ✦ **LCA tools:** There is a whole host of tools for measuring embodied carbon available (such as EC3, Epic, GaBi, Build Carbon Neutral, Athena EcoCalculator, Tally).

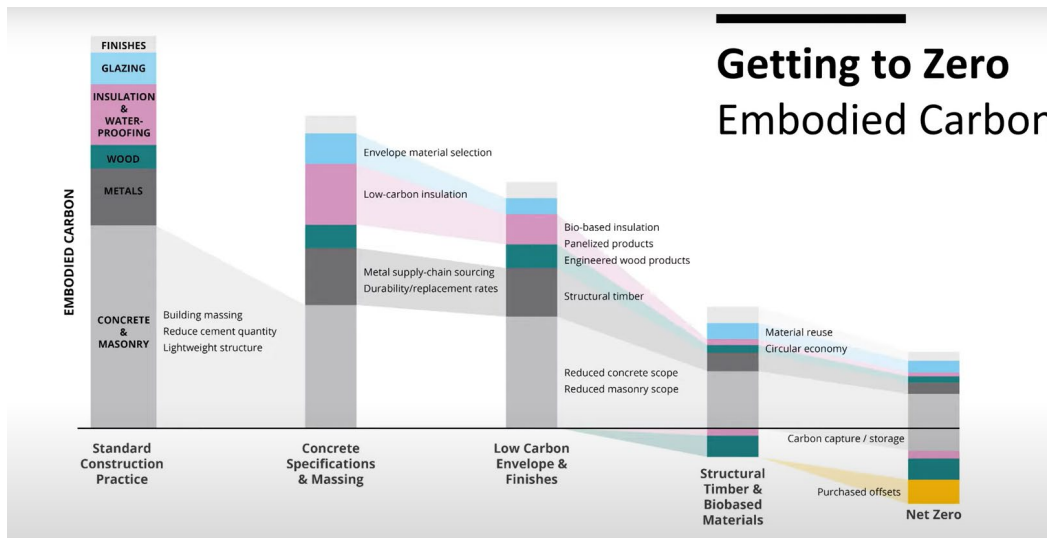


## How to Reduce Embodied Carbon



# Zero Net Carbon Design (ZNCD)

## Considerations in Reaching ZNCD Goals



Source: Kieran Timberlake



## Embodied Carbon — What Do You Think?



**Supports ZNCD Goals**



**Doesn't Support ZNCD Goals**



**A building using a lot of concrete?**

Actions to reduce carbon:\*

- ✦ Substitute for cement with alternative cementitious materials (ACM).
- ✦ Choose recycled aggregate.
- ✦ Select structural shapes and sizes that use less material while keeping the same structural integrity.

\* Courtesy of SDG&E



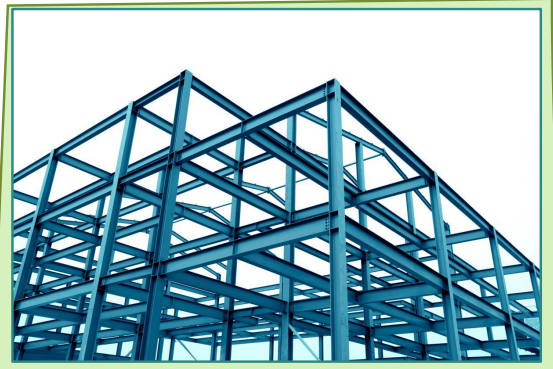
## Embodied Carbon — What Do You Think?



Supports ZNCD Goals



Doesn't Support ZNCD Goals



### A building using a lot of structural steel?

Steel is not great in terms of sourcing but is great in terms of recycling.

Actions to reduce carbon:\*

- ✦ Specify CA or U.S.-made steel and steel with high recycled content.
- ✦ Prioritize electric arc furnace (EAF) production over basic oxygen furnace (BOF) production.

\* Courtesy of SDG&E



## Embodied Carbon — What Do You Think?



Supports ZNCD Goals



Doesn't Support ZNCD Goals



### A building using a lot of dual paned fenestration with thermally broken metal framing?

Actions to reduce carbon:\*

- ✦ Select low-carbon window frame materials.
- ✦ Specify no more than two panes of glazing.
- ✦ Reduce glazing

\* Courtesy of SDG&E





# Embodied Carbon — What Do You Think?



**Supports ZNCD Goals**



**Doesn't Support ZNCD Goals**



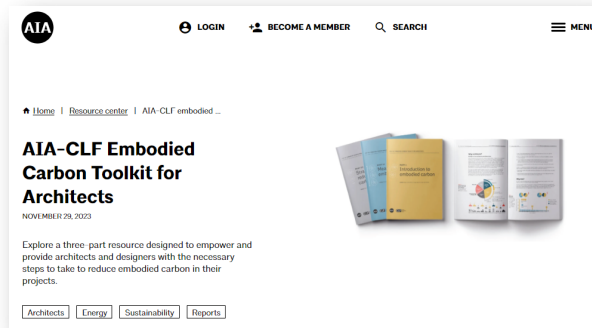
## **A building using a lot of mass timber?**

Better than concrete, since it's a renewable resource that absorbs Carbon when it grows in sustainable forests

Shipping from far away can increase its carbon footprint.



# Embodied Carbon Fact Sheet: Now Available



Also see *Architect's Toolkit for Embodied Carbon*:  
<https://www.aia.org/resource-center/aia-clf-embodied-carbon-toolkit-architects>



Visit [locaenergycodes.com](http://locaenergycodes.com) to download the Fact Sheet.

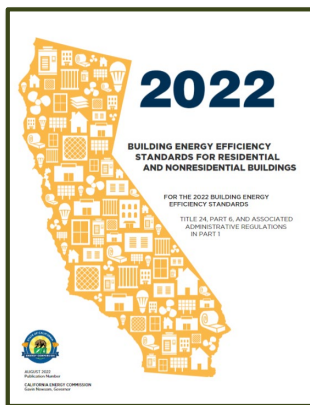


Visit [locaenergycodes.com](http://locaenergycodes.com) to download the Fact Sheet.

Also see Architect's Toolkit for Embodied Carbon: [Carbonleadershipforum.org](http://Carbonleadershipforum.org)

## The Energy Code and Operational Carbon

How does the **2022 Energy Code** support reduce **operational carbon**?



- ✦ **Mandatory** requirements set the minimum energy performance required for many building features across California for all project types and will always make sense
- ✦ **Prescriptive** requirements reduce wasteful and unnecessary use of energy considering cost-effectiveness based on project location and scope of work
- ✦ Compliance metrics in the **Performance** method for new buildings that must concurrently be met:
  - ✦ Building efficiency Time Dependent Valuation (TDV) measurement of energy consumption based on time of day and year; location and building type; and energy source used (natural gas, propane, electricity)
  - ✦ Total TDV energy which takes into account onsite renewable PV, battery storage, and grid flexibility systems
  - ✦ Source energy as a proxy for carbon emissions projected over a 30-year life cycle




# CALGreen Embodied Carbon Requirements

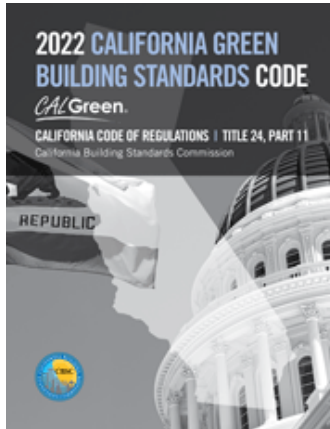
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5. Next Steps

- ✦ When CALGreen’s Intervening Cycle takes effect
- ✦ What CALGreen Requires for Embodied Carbon Compliance
- ✦ What Projects Trigger CALGreen Embodied Carbon provisions
- ✦ Prescriptive & Performance Pathways



# CALGreen Embodied Carbon: Mandatory Requirements



2024 Supplement to California Green Building Standards Code, Title 24, Part 11 (CALGreen)

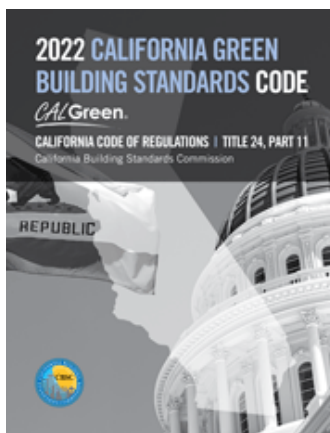
2022 Intervening Cycle Update (effective 7/1/24)	
<ul style="list-style-type: none"> <li>Commercial Buildings &gt;100,000 ft<sup>2</sup> (&gt;50,000 effective 1/1/26)</li> <li>School Buildings &gt;50,000 ft<sup>2</sup></li> </ul>	
Method	<b>Mandatory</b> <i>(pick one applicable to scope)</i>
<b>Existing Buildings:</b> Building Reuse	≥ <b>45% reuse</b> of existing structure and exterior
<b>Performance Path:</b> Whole Building Life Cycle Assessment	Demonstrate ≥ <b>10% reduction*</b> in global warming potential (GWP)
<b>Prescriptive Path:</b>	GWP limits per Table 5.409.3.2, ( <b>175%**</b> ) and Construction documents to include products supporting GWP limits

\*As compared to similar building and location meeting current Energy Code requirements.

\*\*Based on "Buy Clean California Act" and Industry-Wide Environmental Product Declaration (IW-EPD) GWP values; Concrete based on 130% of ready-mixed concrete GWP values.



# CALGreen Embodied Carbon: Voluntary Tiers



2022 California Green Building Standards Code, Title 24, Part 11 (CALGreen)

2022 Intervening Cycle Update (effective 7/1/24)		
<ul style="list-style-type: none"> <li>Commercial Buildings &gt;100,000 ft<sup>2</sup> (&gt;50,000 effective 1/1/26)</li> <li>School Buildings &gt;50,000 ft<sup>2</sup></li> </ul>		
Method	<b>Voluntary Tier 1</b>	<b>Voluntary Tier 2</b>
<b>Existing Buildings:</b> Building Reuse	≥ <b>75% reuse</b> of existing structure and exterior	<b>Tier 1 AND 30% reuse interior</b> non-structural elements
<b>Performance Path:</b> Whole Building Life Cycle Assessment	Demonstrate ≥ <b>15% reduction*</b> GWP	Demonstrate ≥ <b>20% reduction*</b> GWP
<b>Prescriptive Path:</b>	GWP limits <b>150%**</b> and Construction documents to include products supporting GWP limits	<b>IW-EPD GWP limits**</b> and Construction documents to include products supporting GWP limits

\*As compared to similar building and location meeting current Energy Code requirements.

\*\*Based on "Buy Clean California Act" and Industry-Wide Environmental Product Declaration (IW-EPD) GWP values; Concrete based on 130% of ready-mixed concrete GWP values.



# CALGreen Embodied Carbon: Documenting

**WORKSHEET (WS-1)**  
Section 5.405.2 and Section A4.405.2 WHOLE BUILDING LIFE CYCLE ASSESSMENT

**CALGreen Whole Building LCA Reporting Template**

LCA model run:  Overall scope included (check all that apply)

LCA Modeler (optional) (person):  Structure (required)

Date of Model Run (mm/yyyy):  Enclosure (required)

Project Phase at Model Run:  Interiors (optional)

Reference Study Period (years):  MEP (optional)

Software and Version Used:  Site/Landscaping (optional)

Report Carbon Intensity? (y/n):  EIP (optional)

Model Floor Area:

**Mandatory Scope Items**  
Please break out the following in per element emissions by life cycle in kgCO<sub>2</sub>e. Leave blank any sections that were not calculated separately from Whole Building GWP

Use Phase	Upfront Carbon		Use Phase	End of Life		Total
	CI-1	CI-2		BI-1	CI-4	
Baseline Structure GWP (kgCO <sub>2</sub> e)						
Baseline Interiors GWP (kgCO <sub>2</sub> e)						
Baseline Whole Building GWP (kgCO <sub>2</sub> e)						
Proposed Structure GWP (kgCO <sub>2</sub> e)						
Proposed Interiors GWP (kgCO <sub>2</sub> e)						
Proposed Whole Building GWP (kgCO <sub>2</sub> e)						

**Optional Items - Proposed Design ONLY**  
Please break out the following in per element emissions by life cycle in kgCO<sub>2</sub>e. Leave blank any sections that were not calculated separately from Whole Building GWP

Use Phase	Upfront Carbon		Use Phase	End of Life		Total
	AI-1	AI-2		BI-1	CI-4	
Interiors GWP (kgCO <sub>2</sub> e)						
MEP GWP (kgCO <sub>2</sub> e)						
Site/Landscaping GWP (kgCO <sub>2</sub> e)						
FF&E GWP (kgCO <sub>2</sub> e)						

Example CALGreen Performance Worksheet

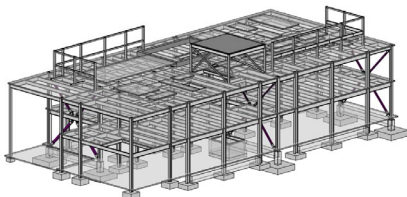
## 2022 Intervening Cycle Update (effective 7/1/24)

- Commercial Buildings >100,000 ft<sup>2</sup> (>50,000 effective 1/1/26)
- School Buildings >50,000 ft<sup>2</sup>

Method	Documenting Compliance
<b>Existing Buildings: Building Reuse</b>	<ul style="list-style-type: none"> <li>Document that every material used in project has GWP less than prescriptive standards</li> <li>Submit Environmental Product Declarations (EPDs) for all materials</li> </ul>
<b>Performance Path: Whole Building Life Cycle Assessment</b>	<ul style="list-style-type: none"> <li>Calculate Whole Building LCA Embodied Emissions</li> <li>Show proposed embodied carbon is project goal % less than Standard</li> <li>Submit EPDs for all materials</li> </ul>
<b>Prescriptive Path:</b>	<ul style="list-style-type: none"> <li>Document that every material used in project has GWP less than prescriptive standards</li> <li>Submit EPDs for all materials</li> </ul>



# Case Study: New School Building



Courtesy of Cal State University

- Case Study 50K sqft new school building
- Designed to be steel frame with metal panel cladding & 2" mineral wool continuous insulation
- How will we document our CALGreen Embodied Carbon compliance?



# Case Study: Prescriptive Method

TABLE 5.409.3  
PRODUCT GWP LIMITS

BUY CLEAN CALIFORNIA MATERIALS PRODUCT CATEGORY <sup>1</sup>	MAXIMUM ACCEPTABLE GWP VALUE (unfabricated) (GWP <sub>allowable</sub> )	UNIT OF MEASUREMENT
Hot-rolled structural steel sections	1.77	MT CO <sub>2</sub> e/MT
Hollow structural sections	3.00	MT CO <sub>2</sub> e/MT
Steel plate	2.61	MT CO <sub>2</sub> e/MT
Concrete reinforcing steel	1.56	MT CO <sub>2</sub> e/MT
Flat glass	2.50	kg CO <sub>2</sub> e/MT
Light-density mineral wool board insulation	5.83	kg CO <sub>2</sub> e/1 m <sup>2</sup>
Heavy-density mineral wool board insulation	14.28	kg CO <sub>2</sub> e/1 m <sup>2</sup>
<b>Concrete, Ready-Mixed<sup>2,3</sup></b>		
CONCRETE PRODUCT CATEGORY	MAXIMUM GWP ALLOWED VALUE (GWP <sub>allowable</sub> )	UNIT OF MEASUREMENT
up to 2499 psi	450	kg CO <sub>2</sub> e/m <sup>3</sup>
2500–3499 psi	489	kg CO <sub>2</sub> e/m <sup>3</sup>
3500–4499 psi	566	kg CO <sub>2</sub> e/m <sup>3</sup>
4500–5499 psi	661	kg CO <sub>2</sub> e/m <sup>3</sup>
5500–6499 psi	701	kg CO <sub>2</sub> e/m <sup>3</sup>
6500 psi and greater	799	kg CO <sub>2</sub> e/m <sup>3</sup>
<b>Concrete, Lightweight Ready-Mixed<sup>2</sup></b>		
CONCRETE PRODUCT CATEGORY	MAXIMUM GWP ALLOWED VALUE (GWP <sub>allowable</sub> )	UNIT OF MEASUREMENT
up to 2499 psi	875	kg CO <sub>2</sub> e/m <sup>3</sup>
2500–3499 psi	956	kg CO <sub>2</sub> e/m <sup>3</sup>
3500–4499 psi	1039	kg CO <sub>2</sub> e/m <sup>3</sup>

WORKSHEET (WS-5)

Section 5.409.3 PRODUCT GWP COMPLIANCE—PRESCRIPTIVE PATH

Responsible Designer's Declaration Statement:

I attest that prescriptive compliance has been performed according to the requirements of Section 5.409.3 and products have met the minimum 10 percent reduction in global warming potential as specified in Table 5.409.3. Furthermore, I will ensure during construction that the material specifications will be reviewed for substantial conformance with the global warming potential limits indicated on the approved plans so at the close of construction the minimum 10 percent reduction in global warming potential is thereby secured.

Signature:	
Company:	Date:
Address:	License:
City/State/Zip:	Phone:

✦ Hot-rolled structural steel: 1.14 < 1.77

**PASS**

✦ Light-density mineral wool board insulation: 1.93 < 5.83

**PASS**

✦ Concrete, 4500-5499 psi: **708 > 661**

**NOT COMPLIANT**



# Example EPD: Structural Steel



## Environmental Product Declaration

According to ISO 14025

Fabricated Structural Steel Sections



EVALUATION VARIABLE	UNIT PER METRIC TON	TOTAL	UNIT PER SHORT TON	TOTAL
Primary Energy, non-renewable	MJ	16,400	BTU	1.41E+07
Primary Energy, renewable	MJ	1,200	BTU	1.03E+06
Global Warming Potential	metric ton CO <sub>2</sub> eq.	1.14	short ton CO <sub>2</sub> eq.	1.14
Ozone Depletion	metric ton R11 eq.	1.61E-12	short ton R11 eq.	1.61E-12
Acidification Potential	metric ton SO <sub>2</sub> eq.	6.04E-03	short ton SO <sub>2</sub> eq.	6.04E-03
Eutrophication Potential	metric ton N eq.	1.36E-04	short ton N eq.	1.36E-04
Photochemical Oxidant Formation	metric ton O <sub>3</sub> eq.	3.72E-02	short ton O <sub>3</sub> eq.	3.72E-02



**Steel Dynamics, Inc.**  
Long Products Group  
Structural and Rail Division

Issue Date: June 30, 2022

Valid Until: June 30, 2027

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Declaration Number: 341

Declaration Number: 341



# Case Study: Performance Method

WORKSHEET (WS-9)  
Section 5.409.2 and Section A5.409.2 WHOLE BUILDING LIFE CYCLE ASSESSMENT

### CALGreen Whole Building LCA Reporting Template

LCA model run

LCA Modeler (company) (private) \_\_\_\_\_ Units \_\_\_\_\_

Date of Model Run (mm/yyyy) \_\_\_\_\_

Project Phase at Model Run \_\_\_\_\_

Reference Study Period (years) \_\_\_\_\_

Software and Version Used\* \_\_\_\_\_

Biogenic Carbon Included\* (y/n) \_\_\_\_\_

Model Floor Area \_\_\_\_\_ m<sup>2</sup>

Overall scope included (select all that apply)

Structure (required)

Enclosure (required)

Interiors (optional)

MEP (optional)

Site/Landscaping (optional)

FTE (optional)

**Mandatory Scope Items**

Please break out the following in per element emissions by life cycle in kgCO<sub>2</sub>e. Leave blank any sections that were not calculated separately from Whole Building GWP

	Upfront Carbon			Use Phase	End of Life	Total
	A1-3	A4	A5	B1-5	C1-4	
Baseline Structure GWP (kgCO <sub>2</sub> e)						
Baseline Enclosure GWP (kgCO <sub>2</sub> e)						
<b>Baseline Whole Building GWP (kgCO<sub>2</sub>e)</b>						
Proposed Structure GWP (kgCO <sub>2</sub> e)						
Proposed Enclosure GWP (kgCO <sub>2</sub> e)						
<b>Proposed Whole Building GWP (kgCO<sub>2</sub>e)</b>						

**A1-A3\***  
(A1) Raw Material Supply, (A2) Transport to Factory, and (A3) Manufacturing

**A4\***  
(A4) Transportation to site

**A5\***  
(A5) Construction Installation or "on-site energy use". Leave blank if unknown

**B1-B5\***  
(B1) Use, (B2) Maintenance, (B3) Repair, (B4) Replacement, (B5) Refurbishment

**C1-C4\***  
(C1) Demolition/Demolition, (C2) Transport to Waste Processing/Disposal, (C3) Waste Processing, (C4) Disposal of Waste

**D\***  
(D) Reuse/Recovery & Recycling Potential

**Optional Items - Proposed Design ONLY**

Please break out the following in per element emissions by life cycle in kgCO<sub>2</sub>e. Leave blank any sections that were not calculated separately from Whole Building GWP

	Upfront Carbon			Use Phase	End of Life	Total
	A1-3	A4	A5	B1-5	C1-4	
Interiors GWP (kgCO <sub>2</sub> e)						
MEP GWP (kgCO <sub>2</sub> e)						
Site/Landscaping GWP (kgCO <sub>2</sub> e)						
F&E GWP (kgCO <sub>2</sub> e)						

- ✦ Calculate Baseline GWP
- ✦ Calculate Proposed GWP
- ✦ Show 10% reduction (if mandatory CALGreen applies; more if Tier I or II)



## Check Your Understanding

### What do you think?

Which of the following are valid compliance paths for **altered** commercial buildings > 100,000 ft<sup>2</sup> under the CALGreen 2022 Intervening Cycle Update beginning July 1, 2024?

[Select all that apply]

- a) ≥ 45% reuse of existing structure and exterior
- b) ≥ 10% reduction in global warming potential (GWP)
- c) GWP limits per Table 5.409.3.2





## Check Your Understanding

### What do you think?

Which of the following are the compliance options for *new* commercial buildings > 100,000 ft<sup>2</sup> under the CALGreen 2022 Intervening Cycle Update beginning July 1, 2024?

#### [Select all that apply]

- a)  $\geq$  45% reuse of existing structure and exterior
- b)  $\geq$  10% reduction in global warming potential (GWP)
- c) GWP limits per Table 5.409.3.2






# Next Steps

**2022 Code Breaker: Embodied Carbon & CALGreen**

1. What is Embodied Carbon?
2. Why Care About Embodied Carbon?
3. Measuring & Reducing Embodied Carbon
4. CALGreen Embodied Carbon Requirements

**5. Next Steps** →

- ✦ Take other Energy Code Ace training offerings



# Virtual Classes



**Nonresidential Standards for Architects & Designers**  
*Online Live Event*



**Single-family Standards for Architects & Designers**  
*Online Live Event*



# Factsheet

**2022 ENERGY CODE**  
**Fact Sheet**  
Title 24, Part 6

**Goals to Reduce Greenhouse Gas Emissions**

This fact sheet explains how newly constructed single-family homes, such as single-family dwellings, duplexes, townhomes of any size and accessory dwelling units (ADUs), can help to meet California's energy goals by installing more efficient systems and moving to cleaner energy sources.

California is aiming to reduce its greenhouse gas (GHG) emissions while creating an energy system that is resilient to climate risks, spurring innovation and a low-carbon transition rationally and intentionally.

California met its 2020 target four years early in 2016, and emissions have continued to drop since then (Figure 1). California's next climate targets are to reduce emissions by 42% below 1990 levels by 2030 and by 67% below 1990 levels by 2050.

According to a California Energy Commission (CEC) report from 2021, homes and businesses account for 25% of California's GHG pollution. These include direct emissions from burning fossil fuels for heating and cooking, gas leaks and refrigerant leaks, plus indirect emissions from generating the electricity used in buildings. See Figure 2 for a snapshot of these GHG emissions in 2018.

**Designing Single-family Homes to Run on Clean Energy**

**Table of Contents**

- 1. Introduction
- 2. All-electric vs. Mixed-fuel Options
- 3. Reduction in Greenhouse Gas Emissions as a Home Is Electrified
- 4. Electric Grid Stability, Storage and Utility Home-generated Solar Electricity
- 5. Energy Code Compliance Options
- 6. Mandatory Electrification Measures
- 7. Prescription Appliances
- 8. Performance Approach
- 9. For More Information

**Energy Efficiency**

When considering cleaner energy sources for a new home, it is important to make sure that the building overall is as energy efficient as possible. Building energy efficiency measures include, but are not limited to:

- Building envelopes (windows, walls, roof, floors and other exterior surfaces) designed to limit heat loss in the winter and heat gain in the summer. Homes in most parts of California will benefit from high insulation levels and high-performing windows, glass doors and skylights. Hot areas will need added features to help keep a building cool, such as cool roof coatings and window overhangs.
- High efficiency and thoughtfully designed space-conditioning and water-heating systems.
- Efficient household appliances, such as those with EnergyStar ratings.

**Progress toward 2030**

**Figure 1. Closing in on California's 2030 Climate Target (Adapted from the CalEPA California Climate Dashboard)**

<https://energycodeace.com/resources/?itemid=91857>



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To begin using your account, click the verify my email address button below:  
[Verify My Email Address](#)

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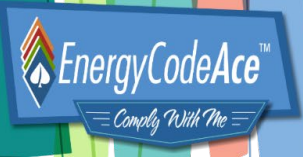
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Company

Chapters

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# Contacts & Course Evaluation




## Thank you

Please feel free to reach out to us with your questions and comments!

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Energy Code Ace	Multiple	<a href="http://energycodeace.com/content/contact">http://energycodeace.com/content/contact</a>	

**Please complete the Course Evaluation**  
Our Survey Monkey wants to hear from you!



Please take our course evaluation: <https://www.surveymonkey.com/r/cb-2022-embodied-carbon>



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55 - INTERNAL

