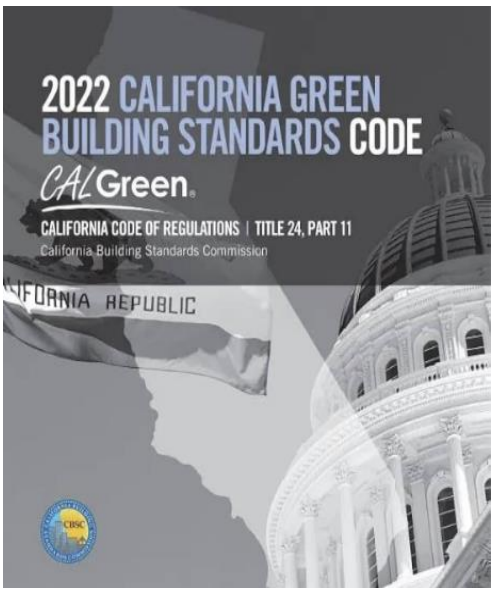
Life Cycle Assessment and Embodied Carbon
July 2024 Cal Green Update

Choose Your Own Adventure

Perhaps you are an old pro in tracking and quantifying environmental impacts in your industrial projects and portfolio. Over the years we have seen this as a growing trend with our institutional clients. If you fit into this category, you may want to skip to the end and review the summary of the upcoming code changes and the two compliance paths.

Or perhaps the following terms are new to you: embodied carbon, life cycle assessment and global warming potential. If that is the case stick around to learn more about the details of the code update and associated terms. In a hurry? Skip to the end anyway. After all, each day is an opportunity to choose your own adventure!

The code adoption cycle:



Why is the code being updated in July? The State of California is on a 3-year code adoption cycle. The current California Building Code is the 2022 code, before that it was 2019. The 2022 CBC became effective January 1, 2023. That is when we saw an increase in EV charger requirements and solar requirements for conditioned spaces. As part of the code cycle the state issues an Intervening Code update in between the 3-year cycle, often clarifying or updating the code.

The July 2024 update is the first of its kind in the U.S. to mandate regulations on embodied carbon emissions. The update is in the California Green Building Standards Code (Cal Green). All new commercial projects submitted for permit after July 1, 2024, that are 100,000 square feet or greater, will have to meet the life cycle assessment requirements.

On January 1, 2026, the threshold will be reduced to 50,000 square feet and greater. There are also requirements for alterations and retrofits that are covered in a later section. The code is available here for more information. See Section 5.409 for the life cycle assessment requirements.

And now a pause in the story for a few definitions:

Embodied Carbon: The amount of GHG (Green House Gas) emissions associated with upstream extraction, production, transport, and manufacturing stages of a product's life. (EPA)

Global Warming Potential (GWP): The climate forcing of a kilogram of emissions relative to the same mass of carbon dioxide (CO2). This number is calculated by the Intergovernmental Panel on Climate Change (IPCC), based on the intensity of infrared absorption by each GHG and how long emissions remain in the atmosphere. GWPs are calculated using a set time horizon. (CARB)

Global Warming Potential Value (GWP Value): The GWPs that are published and used for the purposes outlined below are considered over a 100-year timeframe.

Environmental Product Declaration (EPD): A third-party verified report that summarizes how a product impacts the environment. (CBC)

Life Cycle Assessment (LCA): A technique to evaluate the relevant energy and material consumed and environmental impacts associated with the entire life of a product, process, activity or service, including a whole building. (CBC)

The Fork in the Road - Two Compliance Paths:

An HPA standard approach to writing a paper such as this is to weave in a theme. This is believed to have originated with one of our founders and prolific writers, Byron Pinkert. In his memory and for our own entertainment we continue the tradition. Luckily this code update provides for an easy theme, choose your adventure. There are two paths in the code for compliance. Adventure is a stretch in this case but hey, the theme is for entertainment purposes only, so we are running with it.

The embodied carbon regulations provide two paths to compliance, similar to the way the Energy Code compliance paths are structured.

Two Paths:

Cal Green 5.409.3

Each product that is permanently installed and listed in Table 5.409.3 shall have a Type III environmental product declaration (EPD), either product-specific or factory-specific.

Or

Cal Green 5.409.2

10-percent reduction in global warming potential (GWP) as compared to a reference baseline building per a whole building life cycle assessment.

The Simple Yet Strict Path - Product GWP Compliance/Prescriptive Path:

This path sets limits for embodied carbon for the following materials: structural steel, reinforcing steel (rebar), concrete, flat glass, and wool board insulation.

Like the regulations of the California Energy Code when it was first introduced in 1977, the maximum values for embodied carbon have been set such that they will be relatively easy to meet. Based on our research, the products and materials typically used in recent California industrial projects meet the required threshold using the prescriptive path. The State of California is starting out in a balanced way by setting the thresholds low. This will allow us to focus on reporting and process first. For reporting, EPDs indicating GWP values of the listed materials are required. It is expected that over time the values will be reduced, becoming more and more stringent. This tracks with the same methodology that we have seen from California with the Energy Code.

TABLE 5.409.3
PRODUCT GWP LIMITS

BUY CLEAN CALIFORNIA MATERIALS PRODUCT CATEGORY[1]	MAXIMUM ACCEPTABLE GWP VALUE (unfabricated) ($GWP_{allowed}$)	UNIT OF MEASUREMENT
Hot-rolled structural steel sections	1.77	MT CO_2e/MT
Hollow structural sections	3.00	MT CO_2e/MT
Steel plate	2.61	MT CO_2e/MT
Concrete reinforcing steel	1.56	MT CO_2e/MT
Flat glass	2.50	MT CO_2e/MT [4]
Light-density mineral wool board insulation	5.83	kg CO_2e/MT
Heavy-density mineral wool board insulation	14.28	kg CO_2e/MT
Concrete, Ready-Mixed[2], [3]		
CONCRETE PRODUCT CATEGORY	**MAXIMUM GWP ALLOWED VALUE ($GWP_{allowed}$)**	**UNIT OF MEASUREMENT**
up to 2499 psi	450	kg CO_2e/m^3
2500–3499 psi	489	kg CO_2e/m^3
3500–4499 psi	566	kg CO_2e/m^3
4500–5499 psi	661	kg CO_2e/m^3
5500–6499 psi	701	kg CO_2e/m^3
6500 psi and greater	799	kg CO_2e/m^3
Concrete, Lightweight Ready-Mixed[2]		
CONCRETE PRODUCT CATEGORY	**MAXIMUM GWP ALLOWED VALUE ($GWP_{allowed}$)**	**UNIT OF MEASUREMENT**
up to 2499 psi	875	kg CO_2e/m^3
2500–3499 psi	956	kg CO_2e/m^3
3500–4499 psi	1039	kg CO_2e/m^3

The Harder Yet More Flexible Path - Whole Building Life Cycle Assessment/"Performance" Path:

The second path is what we have dubbed the performance method. To stay with the Energy Code analogy, when the prescriptive requirements became too difficult or too costly to meet, the performance method became a standard practice. It allows for trade-offs so one section can compensate for another. This requires more sophisticated calculations using approved software.

A whole building life cycle assessment is required for the performance path in the Cal Green Code update. Those who are already completing an LCA, for LEED or other sustainability initiatives, may find that this compliance path makes sense for them.

ISO 14040 and 14044 standards shall be used when conducting LCA, excluding operating energy. For this path, Cal Green requires a 10 percent reduction in GWP compared against a baseline standard as defined in the code. Given the established baselines, a 10 percent reduction is achievable using typical products used in a typical industrial building in California.

Alterations and Additions – A Slightly Different Story:

Alterations to existing buildings where the combined altered floor area is 100,000 SF or greater shall complete either the performance or prescriptive method described above or shall reuse a minimum of 45 percent combined of the existing building's **primary structural elements** and **building enclosure**. Per Worksheet (WS-3) the calculations are based on existing and retained square footage of material.

Primary structural elements include foundations, columns, beams, walls, floors, and lateral elements

Building enclosure includes roof framing, wall framing, and exterior finishes. Assemblies deemed unsound or hazardous that are remediated as part of the project shall be excluded.

After January 1, 2026 the new threshold is 50,000 SF or greater.

Summary and Recommendations:

All new commercial projects, alterations, or additions submitted for permit after July 1, 2024, that are 100,000 square feet or greater, shall meet the life cycle assessment requirements. Starting January 1, 2026, the threshold is reduced to 50,000 square feet and greater for new buildings and additions.

The regulations provide two compliance paths that we have shortened to prescriptive or performance, set up similarly to the Energy Code compliance paths.

Product GWP Compliance (prescriptive path): This path sets minimum standards for embodied carbon for the following materials: structural steel, reinforcing steel (rebar), concrete, flat glass, and wool board insulation.

Whole building life cycle assessment ("performance" path): an LCA shall be conducted in accordance with ISO 14040 and 14044 standards excluding operating energy resulting in a 10 percent reduction in GWP as compared against a baseline standard.

The established limits have been set conservatively so we do not see an issue meeting the requirements with either path.

For alternations and additions, a third path is available to reuse 45% of the building's primary structural elements and building enclosure.

We recommend using the Product GWP Compliance/prescriptive path for new construction and for alterations and additions. HPA will provide the maximum allowed values on our drawings for glass and insulation, and structural engineers will do the same for concrete, steel and rebar. We recommend working with contractors in the early design stage and during bidding to confirm that the required EPDs are available and in compliance. For projects planning to complete an LCA for other purposes, the performance path may be the way to go.

Similarly to the California Energy Code, we expect the code requirements to be tightened in the future at which point the LCA path may be the only way to go.