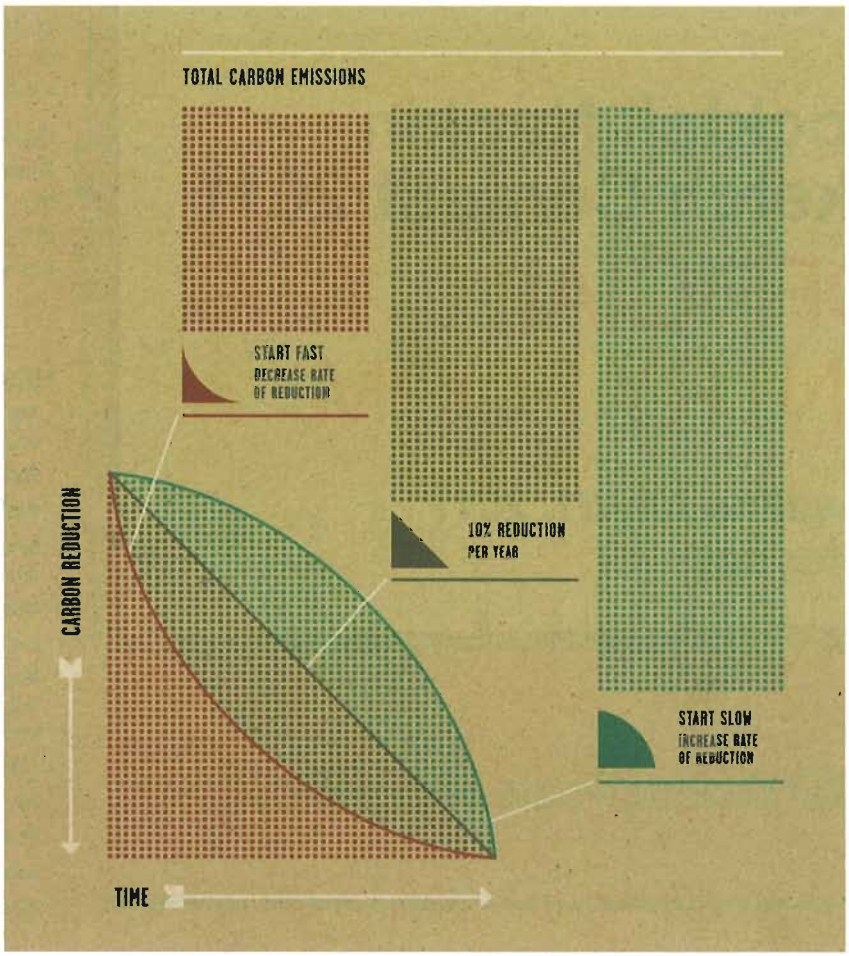
The Clock Is Ticking

The case for reducing embodied greenhouse gas emissions.



Most of the focus on reducing greenhouse gas (GHG) emissions (CO_2 and CO_2 equivalents) in the built environment has been on building operations. Rightly so: building operations—heating, cooling, lighting, and equipment—are responsible for close to 40 percent of the GHG emissions in the United States. But we also need to consider embodied GHG emissions—those from the materials and construction processes that go into making buildings. Embodied emissions are not as large as operating emissions—between 8 to 12 percent in the United States—but there are compelling reasons we should be focusing on reducing embodied GHG in our projects.

Embodied GHG emissions are often measured in terms of years of operating GHG emissions. Depending on the building's efficiency and the materials used to make the building, embodied GHG emissions typically equal 10 and 20 years' worth of operating GHG. If we assume a 100-year building life, embodied emissions don't appear very important. In Siegel & Strain's Portola Valley Town Center project, with predicted energy use about 50 percent below California's Title 24 energy code and a strong focus on using low-embodied carbon materials, we estimated the embodied GHG emissions at about 14 percent of operating emissions.

But for climate change, 100 years is too long a time frame. Climate scientists continue to stress the urgency of GHG reductions. That's why the 2030 Challenge puts the focus on the next 20 years. In that time frame, embodied GHG emissions become much more significant, accounting for 30 percent of the total. But that's not all. Operating emissions and embodied emissions don't happen simultaneously—by the time we start operating a building, the embodied emissions have already occurred. Reducing embodied GHG will be an important component in reducing overall emissions over the next 10 to 20 years.

This sense of urgency can be described more generally as the time value of GHG savings, a concept that George Monbiot illustrates in his book *Heat: How to Stop the Planet from Burning*. The rate of reduction affects the total amount emitted.

In the chart above, the area under each line represents the total amount of GHG emitted over the time period. This graph illustrates the urgency of action. The more carbon savings we achieve at the beginning, the less total GHG is emitted. Embodied GHG emissions occur at the beginning of a building's life, so saving embodied carbon front-loads carbon savings.

How can we reduce embodied GHG in the built environment? More efficient use of materials, use of materials with lower GHG emissions, and using local materials and labor are all good beginnings. From our own work we know we can reduce embodied GHG by 20 percent relatively easily and by 30 to 50 percent with a more aggressive approach. An even faster way to reduce it is to not create it in the first place, by reusing materials, buildings, and infrastructure. Many architects and engineers prefer to work on new buildings, but if we want to reduce embodied carbon quickly, we need to not only build very efficient, net-zero emission buildings; we need to incentivize reusing existing buildings over new ones. GS

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Larry Strain, a partner of Siegel & Strain Architects, has studied the impact of materials for 15 years and, more recently, their contribution to global warming.