BY TED CUSHMAN

‘Embodied Carbon’—What’s Up With That?

Different people have different motivations for caring about the energy performance of buildings. For some, it’s a matter of economizing: What’s the most cost-effective way to create a home that will be cheap to operate? But others in the building and remodeling community have a planet-saving agenda: They’re interested in doing whatever they can to reduce, prevent, or perhaps even reverse the pollution of the atmosphere by gases that induce global warming and threaten catastrophic changes in the earth’s ecosystem.

If you’re in the second group, you’ll be interested in a movement that is rapidly gaining ground among some in the industry: the movement toward considering not just the carbon or other global warming gases that a building will emit in its useful lifetime, but also the carbon that is emitted in the construction of that building—what’s known as “embodied carbon.” It turns out that in the short run—that is, in the next few decades—the CO_2 and other global warming gases that are released into the atmosphere in the extraction and manufacture of the materials that go into a typical house dwarf that house’s carbon footprint in operation.

But when it comes to embodied carbon, all houses are not the same. It’s possible to build a house in a way that minimizes the carbon released in the process. More than that: It’s possible to build a house in a way that actually removes carbon from the atmosphere and stores it, long-term, in the components of the structure itself. Houses, to put it in simple terms, can fight global warming—not just in their operation, but also in their creation. By using appropriate materials and methods, homebuilders can participate, right now, in what’s being called “carbon drawdown.” Homes can be “carbon sinks.”

That’s important because climate change is not just a long-term threat. It’s a crisis that will have major impacts in our own lifetime and will become even more severe in our children’s lifetimes. If your house has low emissions in a hundred years, but releases high emissions while you’re building it this year, the bad part comes now, and the good part comes too late to help. So if you want to take action to confront climate change, you have to take action that’s effective in the short term—ideally, action that’s effective right away.

At $303 per square foot, this 1,650-square-foot Middlesex, Vt., off-grid, foam-free house sequesters 600 kilograms of CO_2.

That was the message heard by builders who attended the keynote session at the New England Sustainable Energy Association’s recent Building Energy conference in Boston, Mass. Jacob Racusin and Ace McArleton, of New Frameworks (Burlington, Vt.), and Chris Magwood, of the Endeavour Centre (Peterborough, Ont.), took a comprehensive look at the issues involved. They started with the goal to “drastically reduce our building carbon emissions within a decade.”

If you want to build a house that’s a carbon sink, you want to stay away from materials with a high “global warming potential” and focus on materials that are effective carbon sinks. That means minimizing things like concrete and plastic foam and focusing on things like wood, cellulose insulation, and other materials that are derived from plants.

Of course, nothing is ever that simple. Analyzing the global warming impact of

Photos courtesy New Frameworks, Endeavour Centre

a construction material's production is complicated and subtle. It can be hard to get good information on materials such as lumber or stone to determine whether they're being produced in a way that adds a lot of carbon to the atmosphere, or not. Even a seemingly green material like straw bales might come from a local organic co-op, or might be transported long distances from an industrial farm.

One way to research materials is to look for an Environmental Product Declaration, or "EPD." "A company will hire a third party to do an EPD," explained Chris Magwood, "and they review all the energy and material inputs and outputs of somebody's entire process and come up with a bunch of figures. The one that we're looking at for this study is the Global Warming Potential (GWP)."

Using EPDs and similar sources to categorize materials, Magwood and Racusin modeled two simple buildings—a single-family dwelling and an eight-unit multifamily building—to analyze how using different materials would affect the structure's greenhouse-gas profile. They found a drastic difference between buildings that used the most carbon-intensive materials and the versions that used materials with lower global warming potential. Just by selecting off-the-shelf materials with low carbon footprints that are available at any home center, they found, it was possible to sharply reduce the building's global warming impact.

Built by Chris Magwood's Endeavour Centre in Clarksburg, Ont., this 1,100-square-foot zero-energy house cost $254 per square foot and stores 24 tons of CO_2.

Said Chris Magwood in an email to *JLC*: "It's a pretty typical set of materials, with cellulose wall and roof insulation and wood fiberboard exterior continuous insulation being the two key carbon-storing substitutions. I've also included some wood flooring and some wood interior walls and exterior cladding."

By selecting less readily available materials that are the most effective carbon sinks (such as straw insulation), it was even possible to construct the building so that it decreased atmospheric carbon just by being built. Scaled up across the entire building industry, the numbers pencil out to mean that in theory, by holding themselves to the smallest carbon footprint possible, builders could remove as much carbon from the atmosphere as is produced by dozens of coal-burning power plants.

The researchers modeled two versions of each building: one that complied with current energy code, and a second, "high performance" version designed to use less energy in operation. When you combine an analysis of the carbon impact of constructing the building with the carbon impact of operating the building for 30 years, the results are striking: The code-compliant building built with carbon-intensive materials added tons of greenhouse gases to the atmosphere by 2051, whereas the advanced building constructed with carbon-sink materials reduced atmospheric carbon over 30 years. Said McArleton, "This is a really important thing for all of us to note: that instead of getting to do less harm, we get to consider that we could do really, really good."

The flip side is also interesting. Over a 30-year period, the numbers show, a high-performance building constructed with materials that have a high carbon footprint releases more emissions than a basic code-compliant building built with less carbon-intensive materials. "This is a big deal," said Racusin. "We cannot just chase energy reduction and expect that we are doing good by the climate." And Racusin noted, "It is also possible to build a net-zero embodied-carbon building using off-the-shelf code-compliant materials. That was encouraging for us. Using actual wood. Using cellulose insulation. Using fiberboard products. We can all access those materials and you can build a net-zero embodied-carbon building tomorrow using those materials."

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