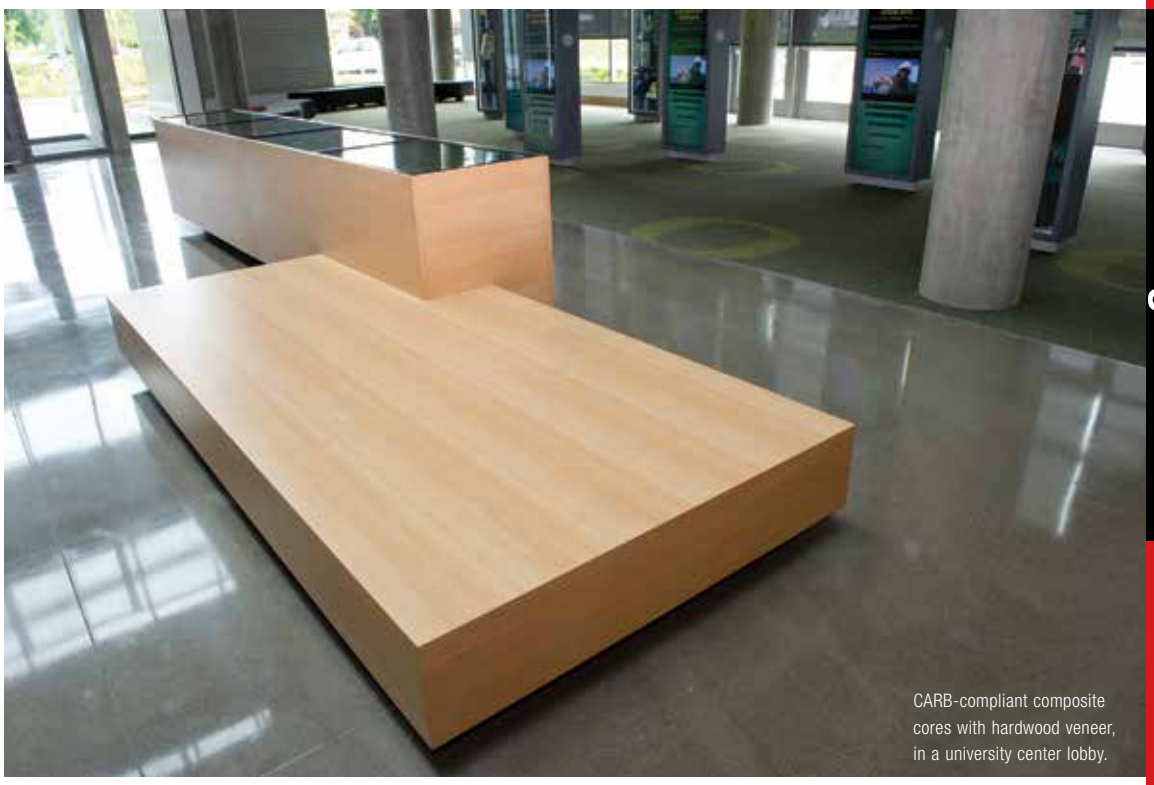
learning objectives

***Interiors & Sources'* Continuing Education Series articles allow design practitioners to earn continuing education unit credits through the pages of the magazine. Use the following learning objectives to focus your study while reading this issue's article. To receive one hour of continuing education credit (0.1 CEU) as approved by IDCEC, read the article and go to interiorsandsources.com/ceus and follow the instructions.**

After reading this article, you should be able to:

- Discuss the environmental advantages of designing with composite panels
- Describe the makeup of a decorative composite wood panel
- Explain the concept of "better than climate neutral"
- Discuss the changes in LEED v4 relative to composite wood panels



CARB-compliant composite cores with hardwood veneer, in a university center lobby.

COMPOSITE WOOD PANELS: THE BIG GREEN PICTURE

Changes in LEED v4 credit requirements are important, but only part of the story.

Few materials on earth are as perfect for their purpose as wood. Trees grow essentially by building themselves, efficiently manufacturing their own construction materials as needed. These materials—a composite of high-tensile cellulose fibers embedded in a matrix of compression-resistant lignin—give wood properties that can't be duplicated by any other manufactured building product.

No matter the form a finished product takes—from solid wood furniture to hardwood plywood wall panels or composite panel-based commercial fixtures—the inherent strength and resilience of wood fiber delivers strength, workability, performance, and value.

The basic nature of this material makes composite wood panels one of the best environmental choices you can make for furniture, fixtures, and interiors. Consider this crash course of facts:

- **Wood is one of the planet's most easily renewed resources.** Annually, U.S. forests generate more wood than is harvested. In 2006 there was 72% more net growth than total removals.
- **Composite wood panels utilize wood fiber left over from other manufacturing processes.** The material would otherwise be destined for landfills or incinerators.
- **These panels are structurally more stable than solid wood, and may be engineered for specific applications and performance characteristics.** These properties ensure a longer useful life by requiring less frequent replacement.
- **Composite wood panels were shown to be "better than climate neutral" in a recent life-cycle inventory analysis.** The wood in composite panels acts as a carbon sink, sequestering more carbon than is expended in their production, transportation, and installation.
- **Rare and endangered wood species are spared by decorative composite wood panels.** High-

Roseburg
A Forest Products Company

definition printed and textured decorative surfaces offer the beauty of any wood type, but with better design consistency and durability.

Throughout this article, you'll explore each of these factors as well as changes in LEED credit requirements.

RESPONSIBLE RESOURCE MANAGEMENT

Logging is part of North America's industrial heritage and remains the heart of many rural communities, but many lumber companies have gone out of business while others have sold out to larger conglomerates, producing adverse effects on the towns that once thrived around them.

Now, few and far between are family-run companies that nurture their communities and maintain their own forests for the long-term health of the environment. Luckily a few do remain, and they drive the industry with a deeper commitment to the future of their resources, the stability of their workforces, and true product innovation.

Composite wood substrates make the most efficient use of our natural wood resources.

Intelligent forest management isn't only common sense—it's good business. Not planting trees after their harvest will deplete them. But the industry knows it can't wait 100-200 years for its seedlings to reach mature size, so it employs responsible resource management. Changes in construction methods and consumption trends play an important role as well.

As the post-WWII population and housing boom erupted, it became glaringly clear that traditional reliance on solid wood for construction would soon decimate our forests. Smart mill owners quickly saw a mass market for a material that had once been a niche product: plywood.

Plywood panels were strong, flexible, workable, and made use of low-quality timber that was otherwise considered waste. It was far more resistant than solid wood to cracking, shrinkage, twisting, and warping—and less expensive to manufacture. Laid up with waterproof adhesives, plywood soon found footing in the military, used for everything from troop barracks to fighter planes.

The spike in demand for baby-boomer housing drove plywood mills into high gear. They streamlined the production process and began to refine multi-ply panels for greater and more specific applications.

By the 1970s larger old-growth logs were mostly gone and the economy was starting to stumble, so forward-thinking manufacturers began refitting their mills for smaller logs. They also diversified, particularly into particleboard and MDF production, which utilize waste produced by sawmills and plywood plants that would have been landfilled or burned.

Over time, wood fiber recovered from discarded furniture and other wood products were incorporated into composite panel production. The small amount of fiber left over is then used as biofuel to cogenerate power for production, reducing the need for fossil fuels and reducing landfill waste to nearly zero.

Engineers soon realized that composite panels could be used as cores for plywood panels, acting as an even more efficient use of wood fiber.

COMPOSITE WOOD, DECORATIVE SURFACES

Particleboard and MDF panels are manufactured by mixing the wood particles or fibers with resin, paraffin wax, and other additives, forming the panel, consolidating and curing it under pressure and heat, and then sanding and sawing to desired dimensions.

Composite panels are highly stable, dimensionally consistent, and can be engineered for special performance properties:

- Moisture resistance
- Fire resistance
- Specific indoor air quality goals
- Density/screw-holding power
- Lightweight
- Different thicknesses and dimensions

For most design specifications, composite panels carry decorative surfaces, ranging from veneer to high-pressure laminate. One of the most common of these options is thermally fused laminate (TFL). TFL is the most efficiently manufactured decorative panel. A printed or solid-color decorative paper is saturated with melamine resin and fused to the composite panel core under heat and pressure, creating a decorative panel in less time than it takes to produce a sheet of HPL.

In most cases TFL is pressed in the same facility that produces the composite panel, eliminating costly transportation, handling, and potential for damage. This means the panel leaves the factory with decorative surfaces on both faces, ready to be made into finished products or installed as decorative millwork. HPL, on the other hand, must be glued to the panel in an extra production step, adding time and cost. After the fabricator adds an edge treatment, it's ready for office desks, bistro tables, retail fixtures, night stands, and more.

The inherent value of TFL, as well as the wide range of designs and textures available, makes it an increasingly popular choice in commercial design projects. As advantageous as TFL panels are for so many uses, producers realize that other materials also have value. As such, TFL suppliers share decor papers and design files with HPL, 3D-laminate, lightweight paper, and edgebanding suppliers for exact surface matches, while offering specifiers cross-reference charts to match or complement colors and structures.

BETTER THAN CARBON NEUTRAL

Particleboard and MDF panels are nothing new. Or are they? Thanks to California Air Resources Board (CARB) standards, board producers have stepped up and modified their products accordingly. Composite panels produced in North America now meet and usually exceed established indoor air quality goals.

Producers have also invested in further research about the true impact of materials and operations. Through a recent lifecycle impact assessment (LCIA), they discovered something extraordinary—that their materials are actually better than climate-neutral.

One major factor in this finding involves the traditional makeup of the panels, as opposed to recent modifications.

Particleboard is made up of small wood particles. In MDF, the wood chips are further refined down to cellulosic fibers, producing a panel with a

smooth surface and homogenous core. Together they represent the highest level of evolution in maximizing the use of wood fiber left over by other manufacturing processes, including waste and recycled post-consumer urban wood.

North American composite panel producers commissioned an LCIA of particleboard and MDF that takes into account all inputs and outputs required to manufacture these products, conducted by the College of Forestry, Wood Science, and Engineering at Oregon State University.

The analysis began with the generation of the forest through harvesting, examining, delivery, product manufacture, use, and disposal. Inputs measured included electricity, fuels, chemicals, and materials use across the resource's lifespan of extraction, delivery, and manufacture. Outputs measured include product, co-product, and emissions to air, water, and soil. Here is a summary of the findings:

USE OF WOOD RESOURCE	PARTICLEBOARD %	MDF %
Wood residue into panel	95.7	84.8
Wood fuel use in mill	3.5	14.9
Wood residue sold	0.74	0.01
Wood particulate emissions	0.03	0.05
Wood waste to landfill	0.06	0.28

Wood is one of the planet's most easily renewable resources, and it's carefully regulated for sustainable management. To ensure wood is from specific sustainable sources, producers pursue certification from third-party groups like the Forestry Stewardship Council (FSC), Sustainable Forestry Initiative (SFI), American Tree Farm System (ATFS), and Canadian Standards Association (CSA).

The reason composite panels are better than carbon neutral is because wood is actually a carbon sink. Consider these facts:

- Wood stores carbon as it grows.
- 50% of wood's chemical structure is absorbed carbon, which is not released back into the atmosphere until it burns or decomposes.
- The carbon sink properties of the wood in composite panels offset more than its carbon footprint, including manufacture and transportation.
- The longer a wood-based decorative panel lasts in an application, the longer that carbon is sequestered.

Composite panels also use significantly less amounts of fossil fuels and feedstock, water, and other resources than other building materials. Consider the differences between the fossil fuels required for each common material compared to MDF (the most resource-hungry of the composite wood panels):

- **PLASTIC:** almost 7 times more
- **GLASS:** nearly 3 times more
- **STEEL:** over 17 times more

DECORATIVE PANELS + ENVIRONMENTAL RESPONSIBILITY

There are many ways to measure the environmental impact of a decorative panel. There's the scientific approach, as in the LCIA above, and there are more intangible factors:

- **EFFICIENCY:** TFL is efficient to manufacture, displacing the additional processing energy and chemicals required by other materials.
- **DURABILITY:** TFL is longer lasting and easier to clean and maintain than veneers and other materials.
- **RESPONSIBILITY:** TFL replaces fragile and exotic solid woods and veneers that are easily damaged—a major advantage, particularly in commercial and hospitality applications.

Too many projects use solid woods or veneers in high-traffic applications where they're quickly scratched, dented, or gouged. Not only is this a waste, it also brings down the perceived value of an entire project. Worse, replacing wood or veneer with the same character and color of the original is nearly impossible because of wood's natural grain variations and changes in color that occur after installation.

For all of these reasons, growing numbers of designers recognize the TFL value proposition of cost and durability, and they specify TFL as the preferred decorative laminate for their projects.

LEED v4 ADOPTS CARB STANDARDS

While LEED v4 is still new, users agree that the updated standard's focus on end results rather than the ingredients used to create composite wood panels is a big step in the right direction.

At issue is the amount of formaldehyde in the resin systems used to bind the layers, particles, or fibers in plywood, particleboard, and MDF panels. Wood itself naturally emits a small amount of formaldehyde, but glues and binders are historically a larger source of emissions from composite panels. In previous versions of LEED, composite wood products were required to be absent of urea formaldehyde in order to support the Indoor Environmental Quality Credit 4.4 for low-emitting materials. Thus, the panels might be NAUF (no added urea formaldehyde) or NAF (no added formaldehyde) to meet this criteria, but there was no requirement for them to reach targeted emissions levels.

When California Air Resources Board Airborne Toxic Control Measure (CARB ATCM) 93120 became law and mandated a reduction in emissions for composite wood products, manufacturers modified their recipes to comply.

In fact, some of the resin systems developed to achieve these lower emission goals involved adding urea formaldehyde, which acts as a "scavenger" that bonds with unreacted formaldehyde to keep it out of the atmosphere, resulting in a lower-emitting board. But the addition of urea formaldehyde meant the products would not comply with the existing LEED requirement prohibiting the use of intentionally added urea formaldehyde (EQc4.4).

This conundrum motivated the USGBC to clarify its intent with a credit interpretation ruling. Therefore, when LEED v4 was introduced in 2013, the low-emitting materials credit for composite wood products makes no mention of urea formaldehyde. It is now simply an emissions-based credit.

Unfortunately, this change has been confusing for the design-build community.

- **ACCORDING TO THE OLD LANGUAGE OF LEED 2009—IEQC4.4:** *Composite wood and agrifiber products used on the interior of the building (i.e., inside the weatherproofing system) must contain no added urea-formaldehyde (NAUF) resins. Laminating adhesives used to fabricate on-site and shop-applied composite wood and agrifiber assemblies must not contain added urea-formaldehyde resins.*

  Composite wood and agrifiber products are defined as particleboard, medium density fiberboard (MDF), plywood, wheatboard, strawboard, panel substrates, and door cores. Materials considered fixtures, furniture, and equipment (FF&E) are not considered base building elements and are not included.

- **CREDIT INTERPRETATION RULING ID#10250: LEED 2009:** *Products using melamine urea formaldehyde (MUF) with added urea*

formaldehyde acting as a scavenger or melamine formaldehyde with urea added as a scavenger to bond with loose formaldehyde within a product do not automatically meet the credit requirements for IEQ credit 4.4.

If the composite wood product using MUF can meet the testing requirements and is found compliant with the California Air Resource Board Airborne Toxic Control Measure (CARB ATCM) 93120 requirements for no-added formaldehyde based resins or the requirements for ultra-low-emitting formaldehyde resins (ULEF), the product can contribute to IEQ credit 4.4.

It was previously unclear how melamine fit within the scope of this credit. This ruling is intended to clarify how to address melamine, not prematurely adopt the LEED v4 credit language for composite wood. Therefore, composite wood products using other amino resins must meet the no added urea-formaldehyde requirements of LEED 2009. Applicable internationally.

- **THE NEW LANGUAGE OF LEED V4: "INDOOR ENVIRONMENTAL QUALITY—LOW-EMITTING MATERIALS"**
  *100% of all composite wood products in the project must meet the CARB emissions compliance standards (CARB approved ULEF Exempt or NAF).**
  ** "Exempt" means the product tests consistently at such a low amount that it gets an exemption from additional testing requirements.*

- **COMPOSITE WOOD EVALUATION:**
  Composite wood must be documented to have low formaldehyde emissions that meet the CARB ATCM for formaldehyde requirements for ultra-low-emitting formaldehyde (ULEF) resins or no added formaldehyde (NAF) resins.

CARB formaldehyde emission limits

RESIN SYSTEM	CARB FORMALDEHYDE EMISSION LIMIT REQUIREMENT (PPM)
NAUF	0.09 maximum (same requirement as CARB Phase 2)
CARB approved ULEF	0.08 maximum (90% of tests cannot exceed 0.05 target)
CARB approved ULEF exempt	0.06 maximum (90% of tests cannot exceed 0.04 target)
CARB approved NAF	0.06 maximum (90% of tests cannot exceed 0.04 target)

CARB'S POSITIVE ROLE IN LEADING LEED

In effect, CARB changed the conversation about composite panels. Instead of asking "Does the product contain urea formaldehyde?" the question will be "Is the product low-emitting?"

After all, better indoor air quality is the ultimate goal, particularly for those who may be extra sensitive to formaldehyde. Rigorous third-party testing and certification of the finished product for low- or ultra-low-emissions targets is a far more effective method than just restricting certain ingredients—ingredients that, despite their names, serve to enhance the desired outcomes for health, safety, and comfort.

The broader goal with LEED v4 is to help users understand the intent behind the credits. LEED 2009 used a numbering system that tended to obscure the real meaning of the credit, to the point that people filling out the paperwork weren't even cognizant of how their project actually performed.

Here's a snapshot of how the composite panel-related LEED language has changed, not just regarding indoor air quality, but resource management and materials sourcing as well:

LEED 2009 *(Old version, still allowed until October 2016)*	LEED v4 *(New version)*
MRc4—Recycled Content • Use materials with recycled content such that the sum of post-consumer recycled content + ½ the pre-consumer recycled content constitutes 10% (1 point) or 20% (2 points) based on cost of the total value of the materials in the project.	**Materials & Resources** *Building Product Disclosure & Optimization—Sourcing of Raw Materials* • Use products that meet at least one of the responsible extraction criteria for at least 25% by cost of the total value of permanently installed building products. (Recycled Content is one of the responsible extraction criteria.)
MRc5—Regional Materials • Use building materials or products that have been extracted, harvested or recovered, and manufactured within 500 miles of the project site for a minimum of 10% or 20% based on cost of the total materials value.	**Location Valuation Factor** is now a multiplier effect in the Materials & Resources credit, rather than its own credit. • Products that are extracted, manufactured, and purchased within 100 miles of the project site are valued at 200% the product cost for meeting other Materials & Resources credits.
MRc7—Certified Wood • Use a minimum of 50% (based on cost) of wood-based materials and products that are certified in accordance with the Forest Stewardship Council's principles and criteria for wood building components.	**Materials & Resources** *Building Product Disclosure & Optimization—Sourcing of Raw Materials* • Use products that meet at least one of the responsible extraction criteria for at least 25% by cost of the total value of permanently installed building products. (FSC Certified wood products are one of the responsible extraction criteria.)
NA—NEW FOR v4	**Materials & Resources** *Building Product Disclosure & Optimization Material Ingredients* • Use 20 products from 5 manufacturers that use various programs to demonstrate the chemical inventory of their product(s).
NA—NEW FOR v4	**Materials & Resources** *Building Product Disclosure & Optimization Environmental Product Declarations* • Use 20 products from 5 manufacturers that have LCA or EPD data as outlined by USGBC.
EQc4.4—Low-emitting composite wood products • Composite wood and agrifiber products must contain no added urea-formaldehyde resins. • 4/1/13 interpretation ruling allowed for melamine urea formaldehyde as long as the product is CARB approved ULEF Exempt.	**Indoor Environmental Quality** *Low-emitting materials* • 100% of all composite wood products in the project must meet the CARB emissions compliance standards (CARB approved ULEF or NAF Exempt).

IN CONCLUSION

Composite wood panels are one of the most essential building blocks in commercial interior design, and even though they're a mature product in the market, users and producers are still learning more about how they can be used to solve construction, performance, and regulatory challenges.

LEED v4's shift from focusing on ingredients to real-world performance is a major step forward in helping the design community put these materials into context, but there's much more to learn about the full impact these materials have on projects. I/S