



### 01 Forest products contain biogenic carbon.

Biogenic carbon is carbon removed from the atmosphere during the growth of biomass and stored in all parts of trees and other plants by the process of photosynthesis. Although this biogenic carbon content of wood varies among species of trees, equating carbon content to 50% of the dry mass of wood provides a useful general approximation of the carbon fraction. This carbon content can be used to estimate equivalent carbon dioxide removed from the atmosphere based on molecular equations. The SEI *Prestandard for Assessing the Embodied Carbon of Structural Systems for Buildings* outlines the recommended approach for calculating biogenic carbon.

In the natural forest life cycle, carbon dioxide is absorbed by trees and emitted back into the atmosphere when trees decay or burn in wildfire. When trees are harvested to make wood products, a portion of the total biogenic carbon is stored within wood materials and sequestered from the atmosphere for the life of the forest product. Residuals, such as roots, leaves, chips and sawdust, are either utilized in secondary markets or left behind in the forest. Wood materials protected by the building envelope, including structural components, typically outlast building service life, which is expected to be at least 50 years. The percentage of biogenic carbon that is reintroduced into the atmosphere as a result of harvesting trees and at the end-of-life of a forest product depends on forestry practices and disposal specifics. Seeking ways to extend a wood product's service life will maximize its carbon storing benefits and delay the release of carbon back into the atmosphere while new trees grow.

### 02 Specify wood from sustainably managed sources.

The carbon benefits of wood products depend heavily on how forests are managed. Unsustainable logging and land conversion can release substantial carbon and harm ecosystems, while sustainable forest management enhances biodiversity, resilience, and carbon storage. Engineers should prioritize wood sourced from operations that follow credible forest certification programs (such as FSC, SFI, ATFS, or PEFC), state Best Management Practices, or other verified sustainable methods. Because certification alone may not guarantee climate benefits and can exclude smaller or public landholders, engineers should also consider "climate-smart" forestry operations, including ecological restoration projects and non-industrial producers such as tribal, family, or public forests. Strategies for sourcing climate-smart lumber include: Engaging local foresters and suppliers to help source wood from forests with low-impact management practices, requesting transparency on forest sourcing, and identifying feedstocks sourced from operations aimed at improving forest health.

### 03 Request forest sourcing disclosure.

The supply chain for wood products is hard to trace, making it difficult to identify the exact origins and environmental impacts of timber products. Engineers can promote traceability by asking for the history of products from source through production, and transparency, by asking for policies and practices regarding sustainability, land use, and monitoring. Since current wood product EPDs lack upstream primary data such as source forest disclosure and associated emissions, engineers should proactively request sourcing information from manufacturers. When chain of custody documentation is available, ASTM D7612 *Standard Practice for Categorizing Wood and Wood-Based Products According to Their Fiber Sources* provides a framework to classify wood products into the following categories: noncontroversial (legal), responsible, and certified sources. Engineers can add forest sourcing disclosure questionnaires to their specifications and review available EPDs for data gaps. This approach not only improves life-cycle impact data for climate-informed design but also supports evaluation of transportation and embodied carbon, fostering regenerative and climate-resilient sourcing.

### 04 Sourcing, location, and mode of transportation affect emissions.

Local sourcing of wood products generally saves emissions generated from the transport of structural wood materials from the manufacturer to the construction site. In addition to travel distance, the mode of transportation is significant. While ocean freight generates the least emissions per unit of mass times distance, vast distances typically amount to greater transportation emissions totals. For inland transport, rail or barge shipments generally emit less carbon per unit of mass and distance than truck shipments. At the start of a project, engineers can inquire about locally available species and grades of lumber to better specify wood that will not require long-distance transportation. Because the cradle-to-gate embodied carbon of wood structural components is relatively low, transportation impacts can amount to as much as half of the upfront embodied carbon footprint, depending on sourcing distance and mode of transport.

## 05 Environmental product declarations exist for wood and engineered wood products.

EPDs are readily available for a variety of different structural wood products including softwood lumber, softwood plywood, oriented strand board, laminated strand lumber (LSL), laminated veneer lumber (LVL), wood I-joists, glued laminated timber (glulam), and cross-laminated timber (CLT). When reviewing an EPD, determine whether it represents an industry average across a geographic region, a specific product/supplier, or a specific facility. EPDs for softwood lumber, for example, have been averaged across the industry in North America and various regions of the United States. Most North American EPDs report environmental impacts from material extraction up to the point the product leaves the factory gate and will include an estimate of biogenic carbon content of the wood product and information on the average moisture content, density, and wood percentage. U.S. Industry-average EPDs have not been published for mass timber products other than glulam, so engineers must determine whether to use manufacturer-specific EPDs or proxy materials as the basis for industry-average modeling data. Facility-specific EPDs for wood products are limited at this time.

## 06 Performance-based specifications help reduce embodied carbon by encouraging efficiency and innovation.

Performance-based approaches can reduce the embodied carbon of timber structures in a variety of ways, including the routine design of timber structures. Structural engineers commonly specify the species and visual grade of lumber used as the basis for design. An equivalent performance specification of mechanical properties, such as allowable design stress and stiffness, would open opportunities to use alternate wood species or machine-graded lumber and generally lead to more efficient wood utilization. With performance-based specifications, wood product selection can be tailored to what is locally and readily available, including underutilized wood species and salvaged wood.

## 07 Use an assembly-level approach that balances fire performance, acoustics, durability, and structural efficiency.

Wood structural systems often require additional non-structural components to meet performance requirements related to fire resistance, acoustics, and durability. To achieve optimal performance, design teams should collaborate to balance and integrate the contribution of each element within the assembly. For instance, mass timber floor systems commonly include a floor topping, acoustic mat, and gypsum board. Thinner floor panels may demand a heavier acoustic mat, and the type and thickness of the topping can vary depending on whether it participates in diaphragm action and the material used. When engineers verify fire endurance through char-depth calculations and demonstrate sufficient residual capacity, they can safely expose timber surfaces by eliminating the need for added fireproofing or finishes. Beyond the technical benefits, exposed wood enhances occupant well-being by fostering biophilia, a natural human response linked to improved health, comfort, and productivity in environments featuring natural materials.

## 08 Modularity reduces construction waste and on-site construction emissions.

Both light-frame and mass timber construction facilitate modularity through pre-fabrication of 2D or 3D components. 2D or “flat pack” panels and framing are designed for ease of transport. 3D or “volumetric” modules deliver nearly complete units of a building to the construction site. Modularity generally speeds the pace of on-site erection and minimizes construction waste and the energy consumed by equipment during installation. Examples of modularity include panelized wood roofs, wall panels and volumetric wood modules.

## 09 Select wood products that optimize structural efficiency and fiber utilization.

Wood products now span a wide spectrum of structural applications, with new engineered options continually reshaping the possibilities for design. The embodied carbon associated with wood product manufacturing can vary widely, influenced by how logs are processed, amount and type of adhesives used, and the drying methods needed to meet moisture requirements. By selecting products that make the most efficient use of wood fiber, engineers can achieve both structural performance and meaningful carbon savings. For light-frame construction, utilizing advanced wood framing (Optimum Value Engineering) can optimize the use of materials to reduce costs and improve energy efficiency while maintaining structural integrity. Designers also have many options to create hybrid and composite systems with other materials that optimize structural efficiency.

## 10 Select wood products that optimize structural efficiency and fiber utilization.

The best outcome for wood structures is reuse that continues the storage of biogenic carbon beyond the original service life of the building. In current practice, reclaimed wood is typically reused to make nonstructural products, such as furnishings, architectural finish products, and home goods. With advancements in technology and design practices, salvaging wood for reuse in structures is becoming more feasible. Existing technology can make condition assessment through Nondestructive Evaluation (NDE), extraction of fasteners through automation, and grading wood quality through proof-loading. Engineers can further facilitate reuse by developing design-for-disassembly methods and building code provisions and referenceable standards for structural reuse. In contrast, at the end of a building’s service life, wood products are typically disposed of into landfills, incinerated for energy, or reused for nonstructural purposes. While wood that ends up in a landfill takes up space and emits greenhouse gases into the atmosphere, some permanent capture of biogenic carbon occurs below ground. Although incineration returns practically all biogenic carbon to the atmosphere, the energy generated by wood incineration substitutes energy produced by fuels from other sources.