# Evaluating the Environmental Impact of Transparent Wood for Sustainable Design

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## Abstract:

Enhancing building energy efficiency is crucial for achieving net-zero targets and addressing climate change. Transparent wood (TW) has emerged as a promising eco-friendly material for light-transmissive structures, reflecting a global shift toward sustainable materials that balance environmental benefits with advanced functionality.

Transparent wood is derived from various wood biomasses through chemical treatments, such as delignification, and is reinforced with resin to enhance mechanical properties. Recent advances in TW include methods such as solar-assisted bleaching, steam bleaching, NaOH delignification, and polymerization techniques, all aimed at enhancing its transparency, toughness, durability, and lightweight properties. These developments have made TW a multifunctional hybrid material with features like flame retardancy, energy storage, and photoluminescence, enabling its use in energy-efficient windows, solar panels, and electronic devices.

While challenges related to scalability and cost-effectiveness persist, this study focuses on evaluating and enhancing the environmental performance of TW. The review offers a detailed analysis of TW's key characteristics, explores its latest applications, and examines critical challenges alongside opportunities for future advancements. Finally, the environmental impact of TW is discussed, emphasizing its transformative potential as a sustainable material and its alignment with global sustainability goals.