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Abstract This study applies Info-Gap Decision Theory (IGDT) to manage uncertainties in early-stage lifecycle assessment (LCA) in the building sector, focusing on carbon emissions and cost optimization. The building industry significantly contributes to global carbon emissions, making robust LCA models crucial for achieving environmental improvements. Traditional LCA methods often overlook deep uncertainties, leading to unreliable outcomes. To address this, this research integrates IGDT, providing a non-probabilistic approach that enhances decision-making under uncertainty. The study develops an optimization model that considers uncertainties in material choices, supplier selection, and transportation logistics, demonstrated through a case study of a Science and Technology Expo Pavilion in Chongqing, China. The results show that manufacturing processes are the main source of carbon emissions, with transportation having a smaller but notable impact. Significant emission reductions can be achieved by using alternative materials like fly ash and volcanic ash in cement production. Strategic supplier selection, based on the cost per ton of CO2 reduction, balances environmental impact with economic feasibility. IGDT provides a robust framework for managing uncertainty, helping building projects to achieve sustainability targets even under deep uncertainty, thereby supporting the industry's efforts towards net-zero emissions.

Keywords value engineering; carbon emissions; uncertainty; information gap decision theory (IGDT).