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AI as a Catalyst: Accelerating the Biobased Construction Transition via TCO Optimization

Research Questions

- How can AI help develop an integrated data and decision-making model that holistically connects all complex TCO components—from land management and carbon storage costs to initial construction costs, operational energy savings, and health benefits?
- How can AI, by analyzing this multidisciplinary data (Engineering/Architecture, Bioscience, and Social Sciences), guide design choices to optimize life cycle costs and accelerate the transition to carbon-negative, healthy, and financially attractive biobased construction systems?

Context Summary

- The construction sector must drastically reduce its carbon footprint, primarily caused by embodied carbon in materials.
- The fundamental solution is a radical transition to biobased materials that can store CO_2 long-term.
- This transition requires a holistic Life Cycle Assessment (LCA), where the supply chain is linked to bioscience (regenerative agriculture).
- The current obstacle is that the carbon costs of conventional materials are not included in the initial price.
- The true offset must therefore be evaluated from the TCO perspective, which includes operational savings due to, among other things, the superior thermal properties of biobased materials.
- These materials ensure a more stable and healthier indoor climate, free from harmful chemicals.
- Sustainable buildings must also ensure social co-benefits and health advantages.
- The major challenge is that the complex and multidisciplinary data (economics, ecology, bioscience, health) is fragmented. An integrated model to quantify the TCO and the ecological/social benefits of biobased systems is lacking.