How can blue biomass contribute to a more sustainable built environment?

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Abstract

The implementation of a circular bioeconomy in the construction industry is a necessary strategy to tackle our global climate crisis. With any single solution having practical and environmental limitations, it is clear that creating a material palette of renewable biogenic building materials will expands access to bio-based construction. Photosynthetic organisms, including marine biomass such as seaweeds and microalgae, utilise solar energy to sequester CO_2, producing biomolecules that can be harnessed for a variety of biomaterials. Organisms such as mussels and oysters mineralise carbon into shells that are often dis-carded as residues. These second and third-generation feedstocks present an opportunity to decarbonise the construction industry. However, we need to better understand how to renew our relationship to this resource in a sustainable manner. This question seeks to explore how we can design and fabricate with, and for, blue biomass materials.

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Context

Blue biomass is defined as marine and aquatic biomass which may be wild, cultivated or consequential (i.e. algal blooms in lakes). It may be implemented into a material palette in an inert, dried or processed state (e.g. bioplastics), or used as living material to enact a biotransformation process such as bioremediation. Its functional properties depend on the production species/biomass source, the growing context/conditions, harvesting and post-processing and present exciting opportunities to design materials and elements that capitalise on their dis-tinct characteristics. For instance, while relatively coarse biomass may be used as a bulk material, biorefinery operations may fractionate blue biomass into highly defined molecules for precise applications.

The cultivation of blue biomass materials offers new avenues for regenerative aquaculture, where marine and freshwater organisms can perform many valuable ecosystem services with little intervention. Biotechnological production of blue biomass may require infrastructure for production and harvesting but has the potential flexibility to be localised; integrated into existing offshore activities; operate as part of industrial symbiosis, or even become integrated into buildings. New manufacturing approaches can extend the traditional use of macroalgae, and other marine materials initiated within vernacular architecture, and reinvent these techniques via contemporary applications in design, bio-construction and bio-renovation**.**

Contributions

The aim of this research question is to seek submissions that progress the idea of building with blue biomass. This may take the form of material exploration: development of novel composites or approaches to negotiating heterogeneity and water content in raw material input. We would like to show-case research that leverages the unique properties of blue biomass to functionalise bio-based architecture components, and advanced design and fabrication approaches specific to these materials.

Understanding the entire cradle to grave lifecycle of blue biomass materials enables us to look for hotspots and generates new target areas for innovation. In this domain we also require quantitative sustainability evaluation to benchmark any claims and assess these materials against sustainability metrics including circularity, LCA or Techno-Economic Assessment. Further, we seek work that addresses questions of how to incorporate the temporal nature of this resource: balancing material requirement with standing stock or scale

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up of cultivation. Design has the potential to consider in a sensitive manner how geographical and climatic variations may lead to diversity in material outputs.

Context

How to contribute to this Question

If you believe you can contribute to answering this Question with your research outputs find out how to submit in the Instructions for authors (https://www.cambridge.org/core/journals/research-directions-biotechnology-design/information/author-instructions). This journal publishes Results, Analyses, Impact papers and additional content such as preprints and “grey literature”. Questions will be closed when the editors agree that enough has been published to answer the Question so before submitting, check if this is still an active Question. If it is closed, another relevant Question may be currently open, so do review all the open Questions in your field. For any further queries check the information pages (https://www.cambridge.org/core/journals/research-directions-biotechnology-design/information/author-instructions) or contact this email (biotechnologydesign@cambridge.org).

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