

Emerging trends to connect biotechnology and environmental sustainability

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Emerging trends to connect biotechnology and environmental sustainability

Biotechnology has become a cornerstone of modern industry, driving innovation toward more efficient, low-carbon, and sustainable production systems. This Special Issue (SI) on “**Emerging trends to connect Biotechnology and Environmental Sustainability**” aims to provide a comprehensive overview of the state-of-the-art progress and current challenges in the field. Its main goal is to highlight innovative biotechnological strategies that foster the transition toward a sustainable and circular economy, bridging scientific research and industrial implementation.

In recent years, biotechnological processes have emerged as key enablers of sustainable industry, offering solutions for cleaner production, energy efficiency, and waste valorization. Advances in microbial engineering, biocatalysis, metabolic modeling, and process automation have opened new frontiers for replacing fossil-based pathways with renewable, bio-based alternatives. However, challenges remain in scaling up these processes, ensuring techno-economic feasibility, and integrating them with existing industrial infrastructures.

The **Special Issue** is associated with the **I COBBIND - Brazilian Congress of Industrial Biotechnology**, a milestone event that **officially united the three main biotechnology meetings in Brazil**. By bringing together researchers, industry representatives, policymakers and students, COBBIND promoted dialogue on advances in biorefineries, bioeconomy, and sustainable bioprocesses, reinforcing the importance of collaborative and multidisciplinary approaches to innovation in biotechnology.

This special issue of *Journal of Environmental Chemical Engineering* contains a selection of 25 papers, covering a wide range of topics that reflect the current frontiers of environmental and industrial biotechnology, organized into five integrative areas, according to their technological, environmental, and microbiological focus:

1. Environmental Biotechnology and Wastewater Treatment, encompassing the development and improvements of biological processes for macro and micropollutant removals and resource recovery.
2. Microbiomes, Microbial Ecology and Anaerobic Processes, focusing on the characterization and application of microbial communities in anaerobic digestion, biogas production and other higher-added value bioproducts, and the stability of biotechnological systems.
3. Waste Valorization, Circular Economy and Bioenergy, exploring the reuse of industrial, agricultural, and urban residues for the generation of energy, biofertilizers, and biomaterials.
4. Bioprocess Engineering and Process Optimization, covering the optimization of physical, chemical, and biological processes, the development of new materials, and the integration of techniques to enhance industrial efficiency.

5. **Agricultural Biotechnology, Bioinputs and Sustainability**, focusing on the use of biotechnology for sustainable agriculture, including biofertilizers, biopolymers, and plant growth promotion.

The guest editors of this Special Issue believe it will serve as a key reference for the biotechnological community, promoting the integration of scientific knowledge with industrial applications. By gathering contributions from academia, industry, and policymakers, this edition aims to foster dialogue, cooperation, and innovation across the bioeconomy ecosystem, advancing the global transition toward a more resilient, resource-efficient, and environmentally responsible industrial landscape - where biotechnology plays a central and transformative role.

The guest and overseeing editors would like to express their gratitude to all the authors for their valuable scientific contributions and to the reviewers for their constructive evaluations, which ensured the high quality of the papers published in this Special Issue.

We also acknowledge the support of the editorial team of *Journal of Environmental and Chemical Engineering* for their assistance during the preparation of this edition. Special thanks to Brazilian National Council for Scientific and Technological Development (CNPq), Brazilian Coordination for the Improvement of Higher Education Personnel (CAPES) and Santa Catarina State Foundation for Research and Innovation Support (FAPESC) for the institutional collaboration towards the realization of the I COBBIND.



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on wastewater treatment, resource recovery, bioenergy and wastewater-based epidemiology.

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