



# Integrative biohydrogen- and biomethane-producing bioprocesses for comprehensive production of biohythane

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## HIGHLIGHTS

- Biohythane is a promising renewable fuel for the sustainable circular economy.
- An integrative two-stage fermentative biohythane production from AD is advisable.
- Meta-omics approaches will further elucidate related microbiomes and their dynamics.
- Metabolic engineering with bio-augmentation will further advance biohythane research.
- Downstream biohythane upgrading and waste CO<sub>2</sub> treatment or valorization is required.

## GRAPHICAL ABSTRACT



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## ABSTRACT

The production of biohythane, a combination of energy-dense hydrogen and methane, from the anaerobic digestion of low-cost organic wastes has attracted attention as a potential candidate for the transition to a sustainable circular economy. Substantial research has been initiated to upscale the process engineering to establish a hythane-based economy by addressing major challenges associated with the process and product upgrading. This review provides an overview of the feasibility of biohythane production in various anaerobic digestion systems (single-stage, dual-stage) and possible technologies to upgrade biohythane to hydrogen-enriched renewable natural gas. The main goal of this review is to promote research in biohythane production technology by outlining critical needs, including meta-omics and metabolic engineering approaches for the advancements in biohythane production technology.

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