From biomass to materials: Unlocking renewable carbon through microbial platform engineering

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The transition toward a defossilised chemical and materials industry requires efficient conversion of renewable carbon from heterogeneous biomass streams. However, lignocellulosic feedstocks remain underutilized due to complex sugar mixtures and incomplete microbial conversion. Here, we present a microbial platform concept enabling robust utilization of such feedstocks. Starting from balanced glucose–xylose co-utilization, we established a substrate-informed metabolic engineering framework that aligns sugar uptake and pathway capacity with central metabolism. This approach was translated to industrial substrates, including cardboard hydrolysates, where engineered *Corynebacterium glutamicum* strains enable scalable glutarate production from waste-derived sugars, reaching titers of up to 70 g L^{-1}. Extension into a genome-encoded multi-sugar chassis enables simultaneous utilization of up to seven sugars, achieving near-complete carbon conversion under industrially relevant conditions. Modular transfer into production strains allows efficient conversion of complex feedstocks, exemplified by fed-batch fermentation of spent sulfite liquor yielding 30 g L^{-1} glutarate at >95% purity. This work defines a scalable platform for integrating heterogeneous biomass into biorefineries and advancing a circular, fossil-free chemical and materials industry, with ongoing extension toward lignin-derived materials.