Project Title: Microbiome-informed Prioritization of Functionalized Sugar Building Blocks Release from Seaweed Polysaccharides.

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SUMMARY FOR PUBLIC RELEASE

Objectives of the Project

The goal of this work is to pioneer a halophilic microbiome-informed biorefinery, for the production of functional mono- and very short oligosaccharides as intermediates to commercially-relevant chemical intermediates.

Description of the Project

This work will leverage ocean and seaweed microbial diversity in a bio-inspired chemicals process, with a focus on precise, non-destructive sequential release of intermediates that maintain the chemical functionality in the resulting short chain sugar moieties. The derived intermediates will be further modified and tested in derived surfactant formulations which are estimated to reduce the carbon intensity (CI) by at least 50% relative to the petrochemical equivalent, primarily by reduced energy consumption for key process steps.

By replacing a petrochemical with a biobased alternative, carbon intensity with respect to the use phase and degradation after use will be significantly reduced since CO_2 from degradation will be neutral thanks to the biobased raw material.

UCSD and NREL will leverage an extensive and diverse library of halophilic microbial enzyme diversity, focusing on selection of new deconstruction activities with candidate enzymes.
BASF will formulate, test, and rank heterologously expressed proteins as purified mixed enzyme formulations.

The released functionalized sugar moieties will be tested in innovative biobased synthesis of target intermediates and formulations using novel chemistry as proposed by the BASF team.
Life cycle- and techno-economic analysis will be performed by NREL and BASF to demonstrate the commercial feasibility of successful technologies developed.

The proposed innovations in biocatalysis are broader than creating target chemical intermediates and include a future halophilic (genetically tractable) microbial conversion based on isolation of novel targeted organisms, specifically from the marine microbial consortia available to this project. If successful, this will accelerate discovery and engineering potential for future direct platform chemical intermediate production in novel host organisms and become a game changer in macroalgae conversion.