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Microbial Electrosynthetic Conversion of CO2 and Carbonates into Biogas and Bioproducts

Abstract:

One of the challenges of natural resource derived energy (wind and/or solar) is intermittent production and the resulting energy storage need required to deliver useable energy to consumers during peak periods of consumption demand. Microbially-catalyzed electrosynthetic conversion of wind and/or solar energy into a biogas (methane) and multi-carbon compounds has been proposed as an alternative energy storage method. While the current proposed biobased technologies utilize dissolved CO2, the use of carbonates expands the electrosynthetic cell beyond a simple system but into wastewater and geological reservoirs, which can serve both as carbon and energy reservoirs. The objective of our proposed research is to convert solar and wind energy into a storable biofuel (methane) and other multi-carbon compounds using microbial electrosynthesis of CO2. Our objective will be accomplished in two developmental phases. Objective I, dissolved CO2 and carbonate minerals will be electrosynthetically converted into multi-carbon compounds and methane using a novel acetogenic/methanogenic microbial consortium. Acetogenic bacteria can convert CO2 into acetate and other multi-carbon compounds which can be utilized by other microorganisms to produce methane and high-value bioproducts such as bioisoprene. Objective II, Define optimal conditions for methane and multi-carbon compound production in wastewater (municipal and agricultural) bioreactors and deep subsurface storage reservoirs to facilitate technology scale-up. The proposed project objective will be initiated in year 1 and completed at the end of year 2. The development of microbially-catalyzed electrosynthetic biotechnology will create an alternative to current technologies (i.e., chemical-based batteries) for storing the abundant natural solar and wind energy resources available in Nebraska