Technologies to Increase the Impact and Sustainability of Biofuels

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Abstract
The transportation sector accounts for a quarter of the total CO_2 emissions in the United States. In this sector, the density of stored energy is paramount in order to meet constraints on the volume and weight of vehicles. Biofuels offer the highest stored energy density of any storage device for renewable energy. Furthermore, biofuels can be implemented in the existing multitrillion-dollar infrastructure to process, distribute, and use fossil liquid fuels. However, the most abundant biofuel, ethanol, is not fully compatible with this infrastructure, which limits the amount of fossil fuels it can replace to only about 10 percent of the gasoline we consume. To overcome this challenge we need new biofuels that have better fuel properties than ethanol, such as heavy alcohols. These advanced biofuels are more compatible with gasoline infrastructure than ethanol, store higher energy densities, and have the potential to replace a significantly larger fraction of the gasoline consumed in this country. In this talk, I will present our efforts to engineer microbial strains that produce heavy alcohols using metabolic engineering. To help us in this task, we have developed new technologies in synthetic biology, which accelerate the pace of microbial strain discovery and improvement. In addition, I will discuss our strategies to produce heavy alcohols from lignocellulosic biomass, such as that derived from inedible plants or agricultural residues. This dual approach is essential not only to increase the impact of biofuels on the transportation sector, but also to ensure the sustainability of their production.