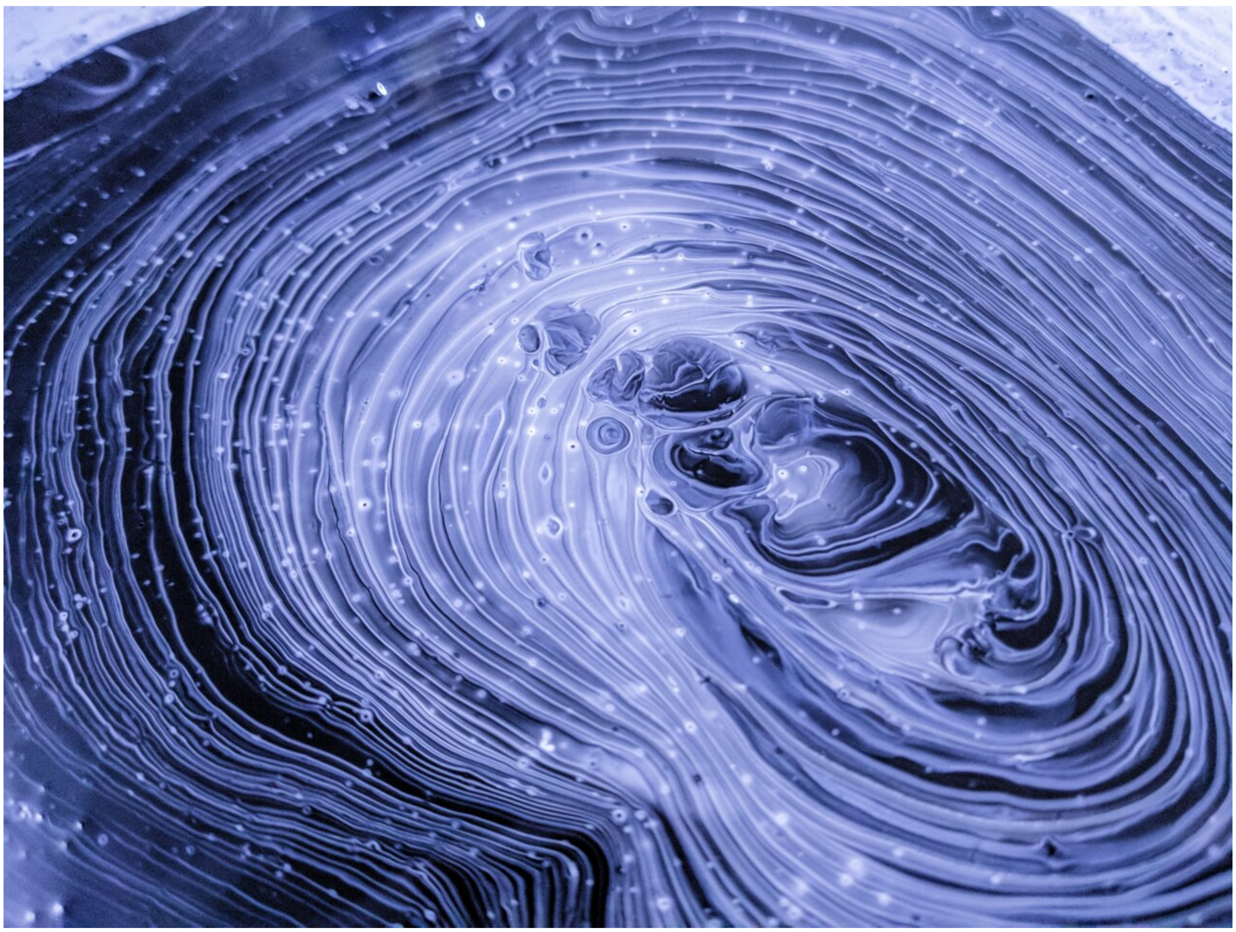
Duckweed as a cost-competitive raw material for biofuel production

March 6 2013



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The search for a less-expensive, sustainable source of biomass, or plant material, for producing gasoline, diesel and jet fuel has led scientists to duckweed, that fast-growing floating plant that turns ponds and lakes green. That's the topic of a report in ACS' journal *Industrial & Engineering Chemistry Research*.

Christodoulos A. Floudas, Xin Xiao and colleagues explain that duckweed, an aquatic plant that floats on or near the surface of still or slow-moving freshwater, is ideal as a raw material for biofuel production. It grows fast, thrives in wastewater that has no other use, does not impact the food supply and can be harvested more easily than algae and other aquatic plants. However, few studies have been done on the use of duckweed as a raw material for biofuel production.

They describe four scenarios for duckweed refineries that use proven existing technology to produce gasoline, diesel and kerosene. Those technologies include conversion of biomass to a gas; conversion of the gas to methanol, or wood alcohol; and conversion of methanol to gasoline and other fuels. The results show that small-scale duckweed refineries could produce cost-competitive fuel when the price of oil reaches $100 per barrel. Oil would have to cost only about $72 per barrel for larger duckweed refiners to be cost-competitive.

The article is titled "Thermochemical Conversion of Duckweed Biomass to Gasoline, Diesel, and Jet Fuel: Process Synthesis and Global Optimization."

More information: Thermochemical Conversion of Duckweed Biomass to Gasoline, Diesel, and Jet Fuel: Process Synthesis and Global Optimization, *Ind. Eng. Chem. Res.*, Article ASAP. DOI: 10.1021/ie3034703

Abstract
Duckweed biomass is gasified in a thermochemical-based superstructure

to produce gasoline, diesel, and kerosene using a synthesis gas intermediate. The superstructure includes multiple pathways for conversion of the synthesis gas to liquid hydrocarbons via Fischer–Tropsch synthesis or intermediate methanol synthesis. Low-temperature and high-temperature Fischer–Tropsch processes are examined using both iron and cobalt based catalysts. Methanol may be converted to hydrocarbons via the methanol-to-gasoline or methanol-to-olefins processes. The hydrocarbons will be refined into the final liquid products using ZSM-5 catalytic conversion, oligomerization, alkylation, isomerization, hydrotreating, reforming, and hydrocracking. A process synthesis framework is outlined to select the refining pathway that will produce the liquid fuels as the lowest possible cost. A rigorous deterministic branch-and-bound global optimization strategy will be incorporated to theoretically guarantee that the overall cost of the solution chosen by the synthesis framework is within a small fraction of the best possible value. A heat, power, and water integration is incorporated within the process synthesis framework to ensure that the cost of utility production and wastewater treatment are simultaneously included with the synthesis of the core refining processes. The proposed process synthesis framework is demonstrated using four case studies which determine the effect of refinery capacity and liquid fuel composition on the overall system cost, the refinery topological design, the process material/energy balances, and the lifecycle greenhouse gas emissions.

Provided by American Chemical Society