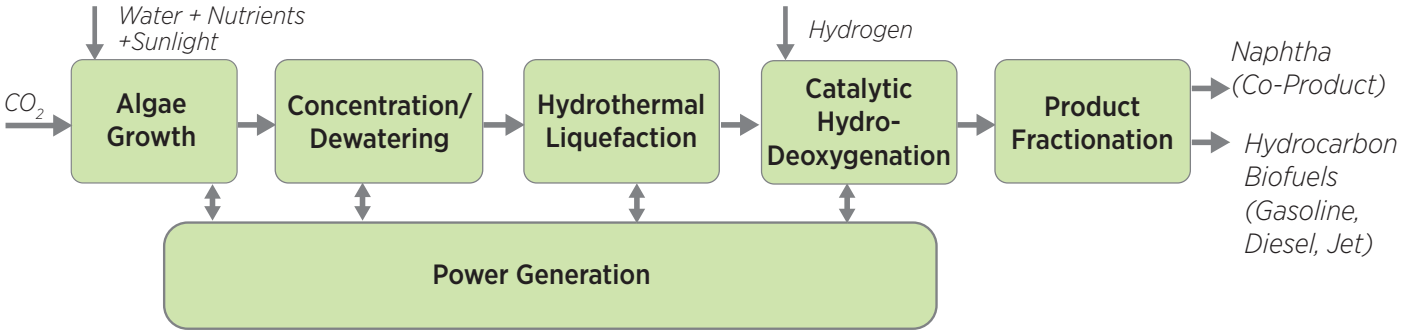
Whole Algae Hydrothermal Liquefaction

In the whole algae hydrothermal liquefaction (AHTL) pathway, bio-oils are separated from water via heat and pressure, so they can be catalytically hydrotreated and converted to advanced hydrocarbon fuels.

Process Block Diagram



Process Design Details

- Microalgal biomass grown via autotrophic pathways is dewatered to 20% solids concentration.
- The slurry of whole algae reacts in a pressure vessel (2000–3000 pounds per square inch and 300°C–350°C) to predominately form liquids with some gas and solids.
- The oil phase spontaneously separates from the water phase.
- AHTL makes use of all algal lipids and biomass—providing high oil yields even from low triacylglyceride (TAG) lipid content algae; polar lipids are not hexane extractable. Overall, hydrocarbon yield appears to increase with a higher lipid content.
- Carbon recovery from waste water is critical for process economics and product yield.

Rationale for Selection

The whole AHTL pathway is attractive to pursue because it allows for the use of all algal lipids and biomass—providing high oil yields even from low TAG lipid content algae. AHTL is especially suited for conversion of wet feedstocks, such as algae, because no drying step is required, and the high-quality oil produced is lower in oxygen and likely easier to upgrade to hydrocarbons than bio-oil derived from other conversion processes. Design, development, and lab testing of technological components have been performed, but more laboratory research is required. The process components have not yet been fully integrated at this scale, though a detailed model has been developed via Auburn University's Aspen Plus® simulator.

Next Steps

To validate current process assumptions, first-hand data on large-scale, outdoor, year-round operation is required. Better understanding of HTL and upgrading reactor configuration is needed to promote efficient conversion and reduce capital costs. Techno-economic analyses will be updated as research and development progresses over the next few years.

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