

Algae Photobioreactor Design Considerations for Commercial Scale Production

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Recent growth in the biofuels industry (ethanol and biodiesel) has put market pressures on agricultural feedstock supplies, primarily corn and soybeans. In order for the biofuels industry to sustain and continue to grow, new non-food or feed biomass feedstocks must be developed. The US Department of Energy funded the Aquatic Species Program (ASP) from 1978 to 1996 to study and categorized microalgae for the production of lipids and starches for biofuels production. This study concluded that microalgae provided far superior production potential in regards to yield per acre than that of soybeans and canola; however, production methods were cost prohibitive when considering the relatively low cost of energy in the 1990's. Recent energy costs increases and potential CO₂ regulation have brought about a renewed interest in industrial algae production as can be witnessed by the number of start-up companies working to develop their own production systems. At this point in time however, none of these start-ups have been able to successfully implement a system that mitigates the high cost of production, which remains a major barrier to entry for this feedstock.

To implement an algae growing system on a large commercial scale there are several key design factors that must be optimized and balanced. The primary factors to be considered are; production rates, value and markets for primary products and co-product, initial capital and start-up costs, and operational costs. Each of these main factors has a list of sub-components and interactions. For example initial capital costs will be balanced with service life, maintenance cost (labor and capital), but also influences production rates and product value. An industrial algae photobioreactor design that can balance these economic factors will be well positioned for wide spread implementation of the technology and provide a new source of biofuels feedstocks. Photobioreactor design efforts should consider the economic production factors early in the design phase to avoid major design flaws as the system is scaled.