BIOMASS ENERGY PRODUCTION: USING ALGAE TO POWER THE WORLD

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Introduction

- Algae is one of the fastest growing plants worldwide.
- Algae uses sunlight more efficiently than other crops and has up to 2x higher energy production. [1]
- Algae is 50% oil by dry weight, more than any other terrestrial crop used for biofuel. [2]
- Algae biofuel production has yet to be technologically optimized to it's full capability.
- Algae biofuel costs $9 a gallon which is expensive. [3]

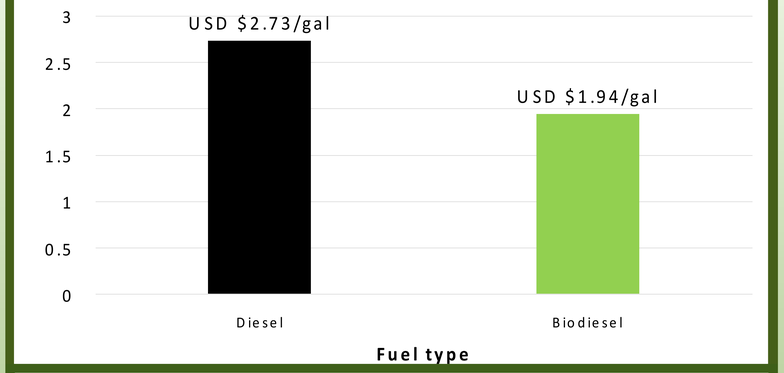

Figure 2. The cost of regular diesel is compared to algae biodiesel. The main cost contributors are salt disposal, $11,256/ha and CO_2 , $115,956/ha. The current market cost of biodiesel can be reduced to the price shown on the graph if CO_2 for production is sourced as a waste from other industries. In addition, the yield sourced from algae biomass has to be increased 30% from current numbers. [6]

	Open Systems (Ponds)	Closed Systems (Photobioreactors)
Process Control	Low control over process	High control over process
Productivity	Low productivity	High Productivity
Operation Costs	Low operation costs and investments	High operation costs and investments
Contamination	High contamination risk	Low contamination risk

Table 2. Open and closed system farming methods are compared. Ponds have a lower front-end cost but are not economic in the long term. Photobioreactors have a high front-end cost but are more productive in the long term. Using photobioreactors will increase the price in the short term, but future adaptation will allow this resource to be sustainable, both economically and environmentally. [8]

Future of Algae

- Algae will become affordable with advancements in biofuel processing technology.
- Algae will become the top biofuel option because of its ideal properties for producing oil.
- The growth of algae per unit area needs to increase to reduce costs of biofuel production.

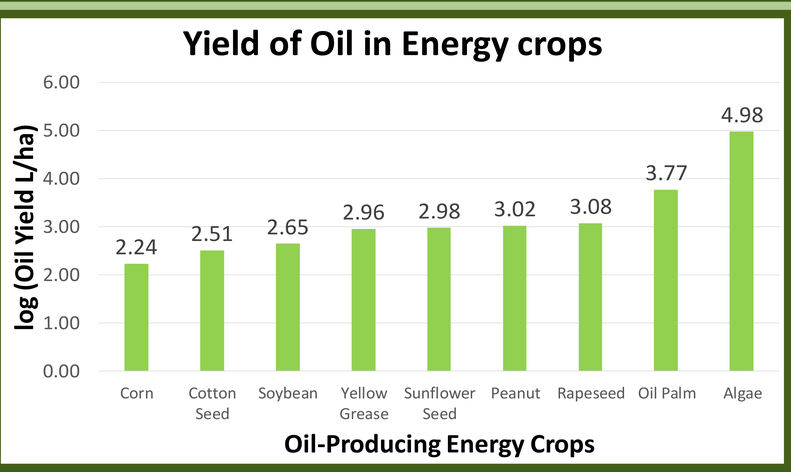

Figure 1. High oil yield from algae compared to other commercial oil-producing crops. Sourcing biodiesel from conventional crops is more farming-intensive, making algae a strong choice as a source of biodiesel. Algae is more space efficient, with 32% more oil yield per hectare than the second most yielding crop. [4]

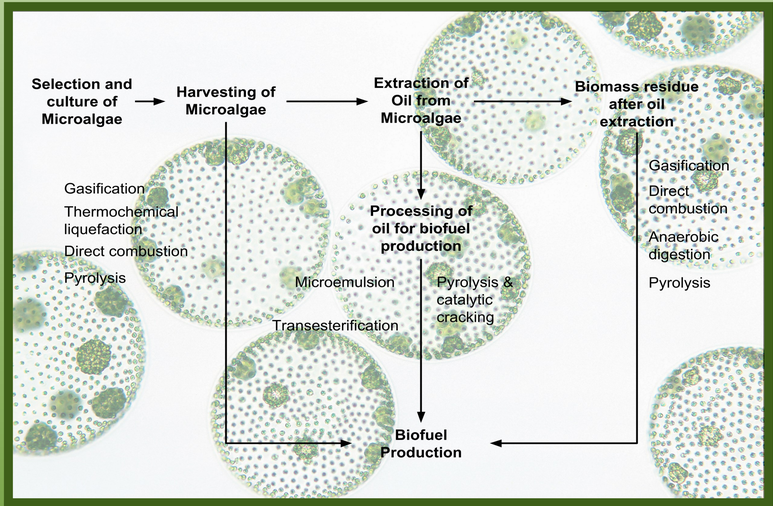

Figure 3. Biofuel production from algae. Various methods can produce biofuel, potentially bypassing steps in the normal production process to boost productivity at the cost of some yield. The most common pathway is harvesting the algae, extracting the oil and refining it to produce biofuel.

	Biodiesel (Algae)	Biodiesel (Different Species)
Technology	Cell Bioengineering	Agriculture in Farms
Production Period	5-7 Days	Several Months or Years
Oil Content	50% by Dry Weight	20% by Dry Weight
Land Occupied (103 L Oil)	100m^2- 130m^2	22,400m^2
Cost	$2.40 per Liter of Oil	$0.80 per Liter of Oil
Potential	Vast Amounts of Potential	Very Limited

Table 1. Biodiesel sourced from algae is compared to biodiesel sourced from other biodiesel producing crops. Algae takes less time and land to produce more oil. The only tradeoff is that the cost of production is 3x that of biodiesel from other species. The cost of biodiesel can be made more affordable than regular diesel by finding ways to increase oil yield. [5]

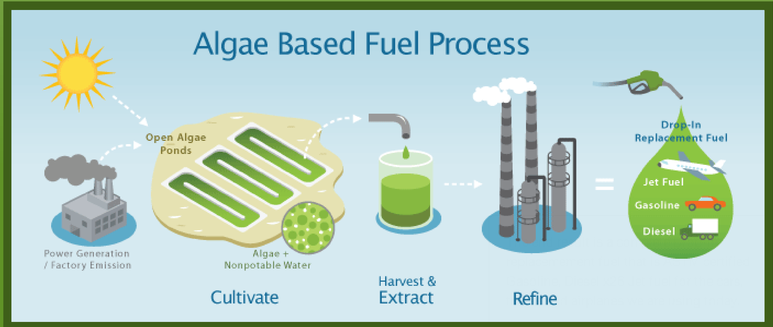

Figure 4. Fuel extraction process, sourced from algae. CO_2 and sunlight in conjunction allow algae to grow in open ponds. The algae is harvested, the algae oil is extracted and refined. Currently, the most efficient refining process involves transesterification, and the refined oil can then be used as a fuel. [7]

References

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