Project OCEAN: Offshore Creation of Energy from Algae

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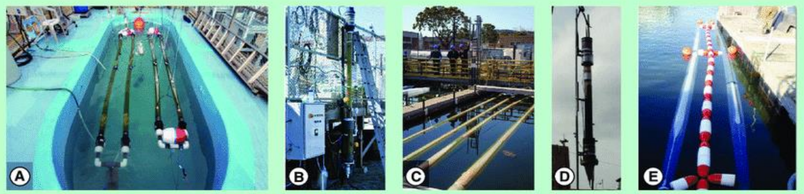
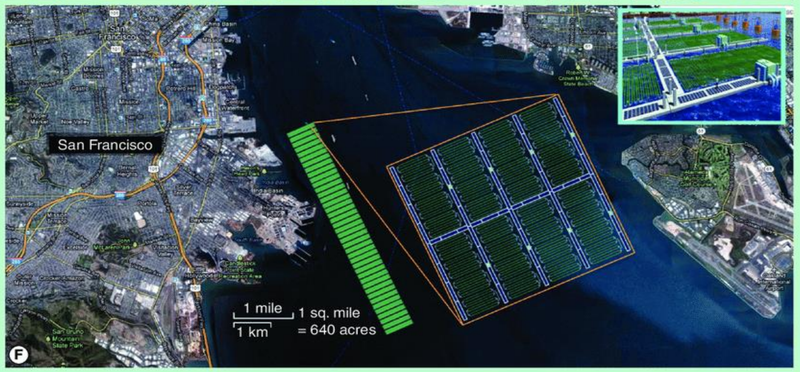
Paetow High School

Function

- Gives access to an renewable and carbon neutral energy alternative to Petroleum
- Ability to switch between types of algae allows for use in clothing, food. oil, medicine, and the printing industry.

Images





Benefits

- Carbon neutral
- Substitute for Petroleum
- Reduces C02 emissions
- Ability to switch between different types of algae quickly
- Renewable source
- Fast growth rate

Sources

- https://www.energy.gov/sites/prod/files/2016/05/f31/algae_efroymson_9619.pdf - Tom Esposito, TopSpin Design Works, NASA
- https://www.researchgate.net/figure/The-components-and-a-hypothetical-site-for-offshore-membrane-enclosures-for-growing_fig1_230757253 - Jonathan

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The Challenge

Our Challenge was to design and build an offshore algae farm,develop a product line from the algae and describe its uses. We also had to provide an expected construction time and time from start up to delivery of first product.

Research and Previous Solutions

Our Previous solution was going to be something similar to Algae Centrifuge Harvesting but our system was going to be too complex, the materials were going to be to expensive and not cost effective and was going to lack efficiency.

For Research what we did was search for multiple documents and articles to educate us on the different ways to harvest algae in order to later on be produced into byproducts.

Our Project

Our project is an offshore farm where the algae is grown, and then collected and put in the facility. Where its processed electro water separation machine that uses electricity in small, programmed doses to gather up oils and suspended solids. Which can be used to easily separate algae from the water. And then using a process called transesterification using barium acid and methanol to create the biofuel. Left over Algae can then be used to make all types of powder, oil, butter and flour. It can be incorporated into all types of food products — baked goods, burgers, beverages, ice cream, infant formula or snacks. The additive also can be consumed by itself, or with other ingredients to enhance flavor.

Implications

- Cost- our original idea for the algae farm was not cost efficient, therefore we decided to scratch it out
- Efficiency- Our original idea for the algae farm was also not efficient enough since the materials that we were going to use would've caused problems later on in the future
- Complexity- Another implication was the complexity of the algae farm, the system that we were going to use to harvest the algae was to complex and it could have caused more problems later on in the future

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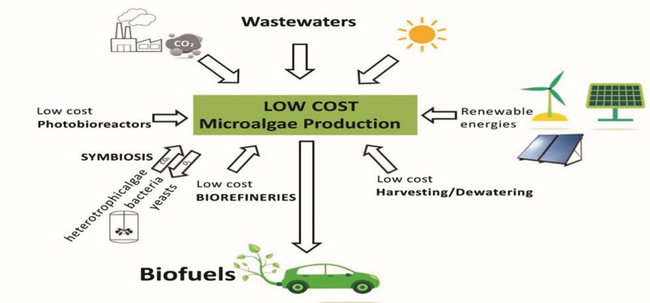
Cost of Algae Bio Fuel

Algae biofuel startup Solix, for instance, can produce biofuel from algae right now, however, it costs about **$32.81** a gallon.

https://www.eurekaselect.com/143885/article - picture credits



Cost of Algae Farm

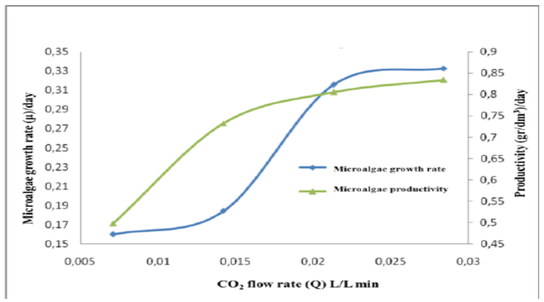
How much does an algae farm cost?

Michael Briggs gave an estimate of $80,000 per hectare for the construction costs to build the algae ponds. $80,000 divided by 2.47 = 32,390 rounded. We will say $32,500 per acre. $32,500 times 250 acres = **$8,125,000 construction costs for a 250 acre algae farm.**

Growth Rate of Algae

Microalgae grow fast, and some can **double in size in 24 hours.** The other type of algae, macroalgae, are more commonly known as seaweed. They are fast-growing marine and freshwater plants that can grow to considerable size.

https://www.researchgate.net/figure/Growth-rate-and-productivity-of-microalgae_fig3_230799004 - H. Hadiyanto; picture credits



Negatives of Growing Algae

Algae biofuel is expensive to produce and fossil fuel prices are still sufficiently low-cost. According to a 2010 research study by the Lawrence Berkeley National Laboratory, producing fuel from algae grown in ponds at scale would cost between **$240 and $332 per barrel.**

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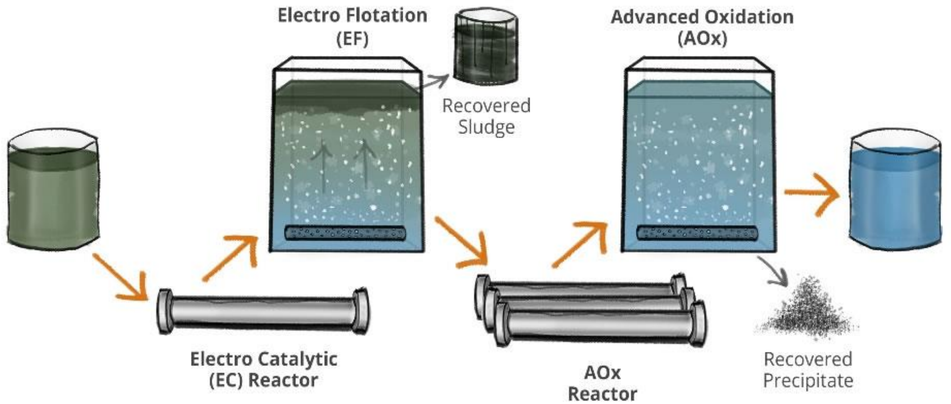
Electromagnetic Water Seperation Method

Waste water enters the system through continuous tube-shaped inline Electro Catalytic Reactors. These reactors optimize contact between their active components and the water flux. The process is an energy efficient continuous system.During the Electro-Flotation stage, an array of reactors at the bottom of the flotation tank produces gases electrochemically, in a controlled manner, resulting in a finely bubbled "cloud". This stage separates the suspended coagulated material and completes the process of breaking the oil emulsion initiated in the previous stage.



https://www.originclear.com/tech/technologies/electro-water-separation - picture credit, origin clear

Advantages of Electromagnetic Water Seperation

We chose EWS because it costs only 4000 dollars. It also doesn't require high infrastructure or high maintenance and is able to process the algae quickly and safely.

Disadvantages of Electromagnetic Water Seperation

Some disadvantages might be the cost of it in the future because it uses electricity to separate the algae, the cost of the electricity to fuel it might add up in the future

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Timeframe

0-6 months:

To start the construction of the Offshore Algae farm we'd need to select a location, a construction team, plan out costs and begin building this should take about 6-7 months to build it.

7-9 months:

From there we need to pick out the type of algae we want and then put them into the algae farm and let them grow

10-12 months:

From there the algae that's grown is processed through the EWS and made into biofuel, the subsidies left over is processed into other sources of revenue and everything is shipped out and sold to the public

12-13 months:

Within this time the consumers will begin to receive the products and be able to use them

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Video