Algae: An Alternative Potential fuel to the conventional fuel for the betterment of humankind

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Abstract: Algae fuels present an exciting opportunity. It is also widely accepted that algae alone and no other bio-feedstock have the ability to replace the entire global fossil fuel requirements. Algae present multiple possibilities for fuel end-products biodiesel, ethanol, methane, jet fuel, bio-crude and more [1]. Algae or algal biomass can be processed to create a variety of biofuels, including ethanol or methanol, With processes such as cellulosic fermentation (for deriving ethanol), gasification (for deriving biodiesel, ethanol and a wide range of hydrocarbons), or anaerobic digestion (for methane or electricity generation), it is possible today to use macro algae as the feedstock for biofuels. The term algae can refer to microalgae, cyanobacteria (the so called "blue-green algae"), and macro algae (or seaweed). Under certain conditions, some microalgae have the potential to accumulate significant amounts of lipids (more than 50% of their ash-free cell dry weight). These characteristics give great potential for an immediate pathway to high energy density, fungible fuels.

Index term - Algae, conventional fuel, microalgae, ethanol, fossil fuel

I. INTRODUCTION

Algae has a great potential in order to serve the world's fuel requirements. It does not affect the food chain of human beings. Producing biodiesel from algae requires selecting high-oil content strains, and devising cost effective methods of harvesting, oil extraction and conversion of oil to biodiesel [2]. This characteristic has made biodiesel the favorite end-product from algae.

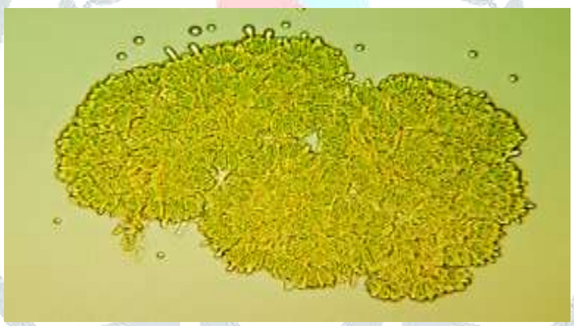


Fig.1. Microalgae strain

These fuels can also be produced using other algae feed stocks and intermediates, including starches and sugars from cyanobacteria and macro algae. In addition to fungible biofuels, a variety of different biofuels and products can be generated using algae precursors. There are several aspects of algal biofuel production that have combined to capture the interest of researchers and entrepreneurs around the world. These include:
1) High per-acre productivity,
2) Non-food based feedstock resources,
3) Use of otherwise non-productive, non-arable land,
4) Utilization of a wide variety of water sources (fresh, brackish, saline, marine, produced, and wastewater),
5) Production of both biofuels and valuable co-products, and 6) potential recycling of CO_2 and other nutrient waste streams [1].

The global market for algal biomass is poised for explosive growth in the next ten years. Algae is attracting increased investment and interest from biofuels, petroleum, and agribusiness industries. Algae 2020 finds the US and Europe cannot grow enough corn, soy, or rapeseed to meet their biofuels targets. Fast growth in US and European biodiesel markets from 2007-2010 has led to increased bio-refining capacity but a shortage of feedstock. Algae 2020 finds long-term demand for biofuels in the US, EU and Asia will create new opportunities for algae and other non-food feedstocks to meet ambitious targets for biodiesel, ethanol, and advanced bio refineries for biofuels[4].

Around the world, an urgent demand for alternative, sustainable fuels and feedstocks is growing. Compared to other feedstocks, algae can provide a high-yield source of biodiesel, ethanol and aviation fuels without compromising food supplies, rainforests or arable land. For biodiesel algae strains with high oil productivity will bring much-needed feedstock to bio refineries world-wide.

II. ALGAE BIOFUEL

Micro-algae are the fastest growing photosynthesizing organisms. They can complete an entire growing cycle every few days. Under optimum growing conditions micro-algae are reported to produce up to 15,000 gallons of oil/acre/year.

One of the main drivers for adoption of biodiesel is energy security. This means that a nation's dependence on oil is reduced, and substituted with use of locally available sources, such as coal, gas, or renewable sources [5]. Thus a country can benefit from adoption of biofuels, without a reduction in greenhouse gas emissions. While the total energy balance is debated, it is clear that the dependence on oil is reduced. One example is the energy used to manufacture fertilizers, which could come from a variety of sources other than petroleum. The US National Renewable Energy Laboratory (NREL) states that energy security is the number one driving force behind the US biofuels programme and a White House "Energy Security for the 21st Century" paper makes it clear that energy security is a major reason for promoting biodiesel [6]. The EU commission president, Jose Manuel Barroso, speaking at a recent EU biofuels conference, stressed that properly managed biofuels have the potential to reinforce the EU's security of supply through diversification of energy sources[5].

Capable of fixing CO2 in the atmosphere, thus facilitating the reduction of increasing atmospheric CO2 levels, which are now considered a global problem. Algae biofuel is non-toxic, contains no sulfur, and is highly biodegradable.

1. FIRST GENERATION BIOFUELS

Feedstock such as soybeans, palm, canola and rapeseed are considered first generation feedstock for biodiesel production, as they were the first crops to be tried for biodiesel production. Most first generation biodiesel feedstock could be used alternatively to make food for humans as well [7].

Pros:

- Simple and well-known production methods
- Familiar feedstocks
- Scalable to production capacities
- Easily blended with existing petroleum-derived fuels
- Experience with commercial production and use in several countries

Cons:

- Feedstocks compete directly with crops grown for food
- Production by-products need markets
- Low land-use efficiency
- Modest net reductions in fossil fuel use and greenhouse gas emissions with current processing methods

III.SECOND GENERATION BIOFUELS

Non-food bio-feedstocks are considered as feedstock for second generation biodiesel. Either by using standard transesterification method, or by using technologies such as biomass to liquid, such feedstock could be converted to biodiesel.

Pros

- Eliminates competition for food and feed
- More efficient and more environmentally friendly
- Less farmland is required mixture of crops can be used by-products are produced which can be used in other chemical processes or burned for heat and power.

Cons

Same downfall as the first generation fuels but without as great of an eco-imprint.

IV.THIRD GENERATION BIOFUELS

Algae are considered to belong to the third generation of biodiesel feedstock**.**

Pros

- Superior yields
- Not directly affecting the human food chain
- Grown in places that are not suitable for agriculture
- Enhanced efficiencies or reduction in cost

Cons

- The problem of course is in developing technologies that will enable this kind of biofuel to be more cost effective to make [8].
- Algae can be Grown under conditions which are unsuitable for conventional crop production .Like desert, see water, as seen below

Fig 2- Fields of cultivation

EVOLUTION OF ALGAL BIOMASS

Algae Producers - Scaling Up an Algae Production Venture in Four Phases to Commercialization [9].

Phase 1: Bench/R&D, And Laboratory Projects

Phase 2: Pilot Size Projects - Field Tests with Pilot Projects

Phase 3: Demonstration Projects - Scale-Up of Projects

Phase 4: Commercial Projects - Projects in Commercial Operation

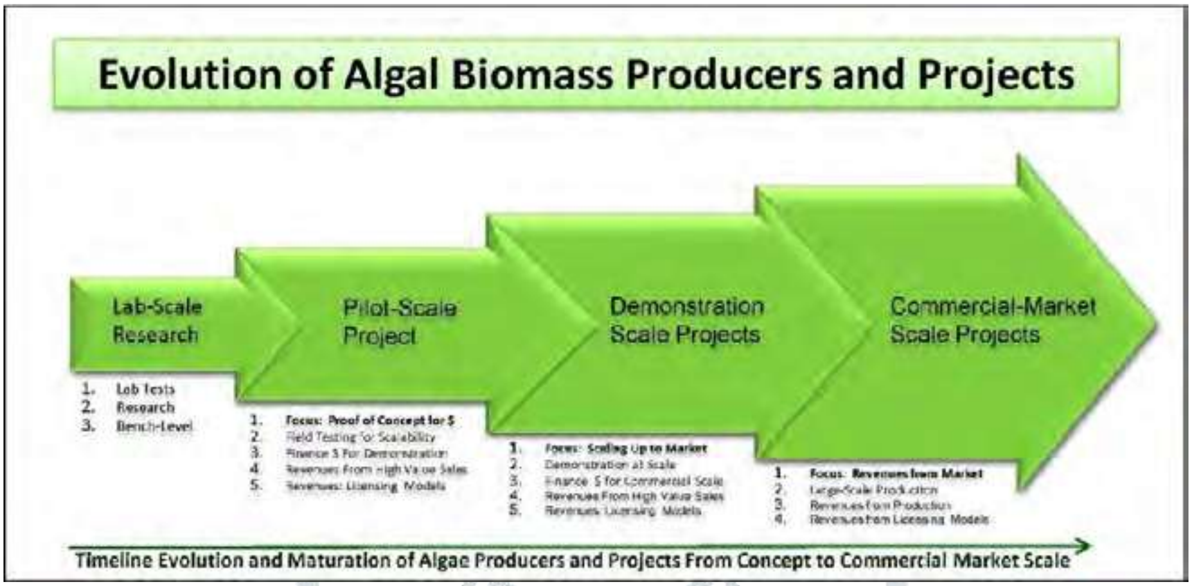


Fig.3 - Algae evolution

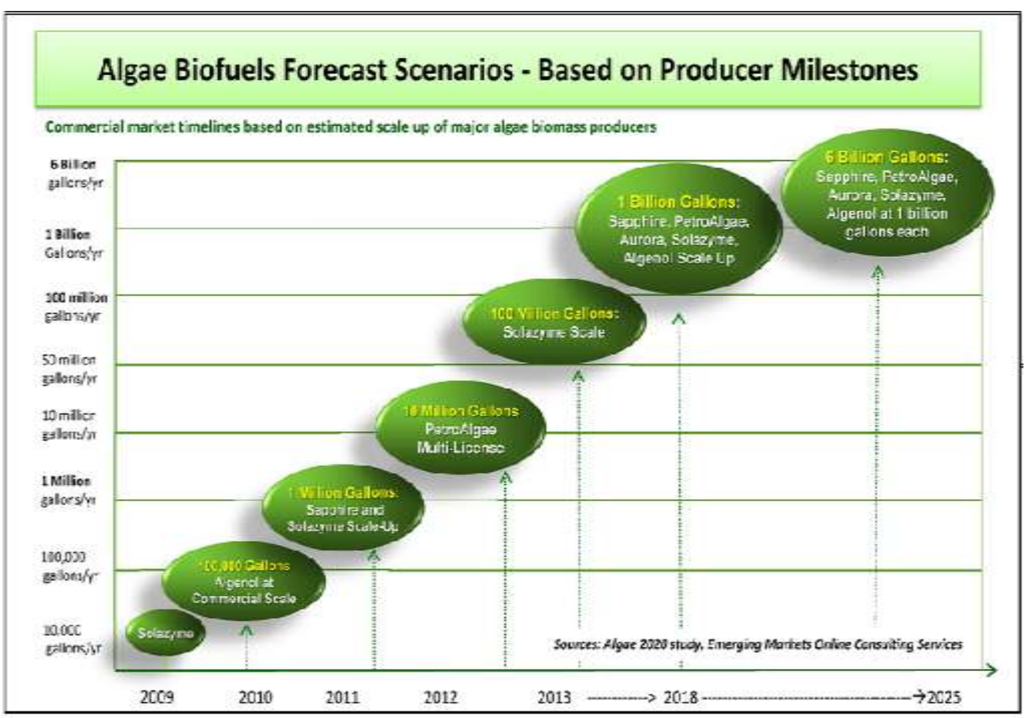
V. FUTURE SCOPE

A. Mass cultivation of microalgae is currently undertaken in several parts of the world to produce fish feed, pharmaceuticals and health supplements.

B. Its innovative clean fuel production technologies to create oil wells (literally) at our desired locations and take a firm grip over fuel pricing for-ever.

C. It is now possible for Governments/Corporate to participate in "Own a clean fuel manufacturing project" either as investors, promoters or sponsors. Under this innovative business model [10].

D. It is the easy way to do the waste water treatment. This is the field where government is spending lot much money, for reducing the water pollution. Along with this we can get the biofuel also, hence the dual purpose is achieved.



Graph 1- Biofuel forecast

E. Whether you are a large consumer of fuel or an investment company looking for innovative high growth projects, whether you are situated in India or in any corner of this globe, you can now invest in “Own a clean fuel manufacturing project” located in India [10]. With this project, you get a firm grip over the fuel supply from such project/s for long durations (entire life-cycle of the project). You can either use the fuel for your captive consumption or sell it back to grow diesel to get a market related price-compensation leading to huge profits.
F. To discuss the proposal in detail and signing of on the spot term sheets, we are hosting a conference "Clean Fuels Conclave 2011" on 23rd & 24th November 2011 in India. Clean Fuels Conclave shall be covering futuristic drop in Biofuels like Bio-CNG, Green Diesel, ATF, Bio-Crude etc [5].
G. Next Generation Fuel Technologies are emerging as a trillion dollar futuristic industry and this conclave offers many value added opportunities for Industries, Research Institute, Investors and Entrepreneurs.
H. Over 5000 scientists, top management experts and delegates from leading industries from more than 20 countries across the globe have worked in this field.

VI. CONCLUSION

Algae has a great potential in order to serve the worlds fuel requirements. It does not affects the food chain of human beings. The high yields of biodiesel, ethanol, methane shows the efficiency of algal biofuel. Algae captures atmospheric CO2, hence helps in reduction in global warming and pollution. Wastewater treatment is the major positive factor. Apart from all data there is need of high end research for less costly commertial production.

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