Algae Investment Trends & Advanced Biofuels Insight

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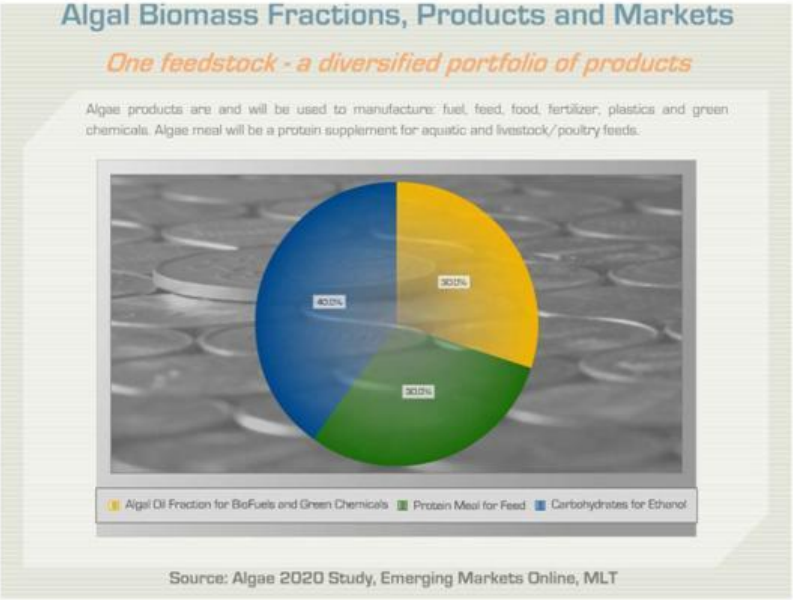


The global biofuels industry is entering a new decade of emerging opportunities and considerable challenges in reaching 2020 targets. The global economic recession is already shaking out many of the would-be players in a crowded algae space, and favoring new players with improved strategies. Why are some algae companies attracting capital, and scaling up their enterprises while others continue to peer into the “valley of death” from the laboratory to the pilot phase?

In 2008 and 2009, Emerging Markets Online (EMO) set out to find how leading companies in the algae business are beating the odds and adapting to rapid changes in markets, regulations and technologies. Over the course of 18 months, EMO visited with dozens of algae producing facilities, laboratories and pre-commercial projects to find out what it takes to qualify for investment and gain an advantage as an aspiring algae producer.

During this time, EMO also ran collaborative R&D workshops and participatory webinars with support from leading minds from the *Biofuels Digest*, the American Biofuels Council, the National Algae Association, *Biofuels International,* start-up incubator the Houston Technology Center; winners of government grants for US DARPA and DOE contracts, as well as thoughtful guidance and insight from members of the Algal Biomass Organization, the European Algae Biomass Association, the National Biodiesel Board, and every major oil and gas company invested in the algae industry.

In short, the endeavor spanned stakeholders in nearly every aspect of the algal biomass business. *Biofuels Digest* Editor Jim Lane provided a foreword and guidance on leaders in advanced biofuels companies and insights on business models for

growth. The results were published in Algae 2020 *[1]*, a strategic guide for investors and technology developers.

Based on the results of this massive collaborative undertaking, it is absolutely clear that for any algae producer or advanced biofuels company to receive investment, and grow out of the lab into a commercial enterprise, the practice of strategic due diligence across a range of domains is paramount to success. This requires dedicated research, development, collaboration and diversification to prepare for rapid, transitional changes in regulations, mandates, markets, technologies and subsidies.

Four Keys to Advanced Biofuels Investment

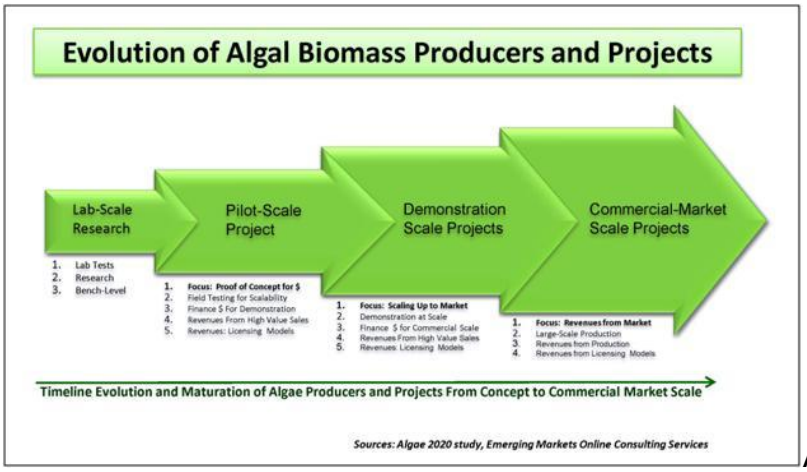
The key findings from Emerging Markets' continuing R&D efforts in *Advanced Biofuels* reveal three common elements are critical for any algae company to attract investment and survive in uncertain regulatory and market conditions. The companies that have successfully attracted capital and graduated from the lab into pilot and demonstration projects have four fundamental elements in common:

1. The production of advanced biodiesel, ethanol, and fungible drop-in fuels.
2. The ability to demonstrate *proof of concept* to investors beyond the lab/bench scale.
3. Most utilizing molecular biology or advanced systems engineering platforms.
4. A diversified portfolio of fuels, advanced biodiesel and ethanol fuels, drop-in biofuels, biojet fuel, green chemicals and biopolymers.

Proof of Concept

Of the 80 or so companies involved in the algae space, less than 25 have moved from stage 1 in the laboratory to stage 2 at the pilot phase during the economic recession. Few have been able to convince investors to risk placing $1 million USD or more to make this necessary transition. If an algae venture is not (a) able to demonstrate and prove its technology works on a small scale or (b) produce more than 1000 tons of algal biomass or at least 100 gallons of algal oil with its partners, it is unlikely investors will take serious notice. Notably, some companies have been able to attract investment based on initial proof of concept at the lab/bench scale via strategic partnerships, early-stage VC money, and government grants.

Advanced Biodiesel, Ethanol & Drop-In Fuels



A common theme is found among the leaders of the field that have progressed into pilot and demonstration scale projects. In addition to biodiesel and ethanol, these organizations are able to produce drop-in replacement fuels from microalgae, and blue-green algae also known as cyanobacteria and other microbes. Drop-in fuels from created from algae and other forms of biomass are the molecular equivalent of kerosene or JP8 aviation fuels, diesel and petrol and are otherwise known as green diesel or renewable diesel, bio-gasoline or green gasoline.

What explains the rising investment trends in *advanced* algae biofuels during an economic recession? Mandates and markets. In the biggest markets in Europe, the U.S., Brazil, China and India, government mandates are requiring large oil and gas refiners to blend in biofuels to their existing infrastructure. In 2008, the U.S. government enforced mandates for ethanol. By the end of 2010, the corn ethanol industry will soon approach the “blend wall” at 10 percent of total gasoline consumption or nearly 13 billion gallons.

Gasoline is the dominant fuel in the U.S., representing approximately 140 million gallons of consumption per year. Most oil and gas companies facing blending mandates, and auto manufacturers and transport companies considering fleet-wide upgrades to E15 or E85 wish to find fungible fuels that are compatible with existing engines, pipelines, storage systems and petrol stations.

The aviation industry faces similar challenges. In 2012, U.S. airline carriers flying into Europe will have to endure imminent carbon penalties, and can not use traditional ethanol and biodiesel fuels in their engines or at high altitudes. Advanced drop-in fuels provide answers to systemic problems and challenges in regulations, infrastructure and sustainability criteria. It is a tall order to fill, and most algae producers have barely scratched the surface in this regard to date with the exception of a few.

Investment Trends — Experience Matters

To meet the specs for advanced drop-in fuels, petrochemical engineers will tell you every molecule counts. In response, molecular biology pioneers are leading the charge in developing platforms from algae, cyanobacteria, and microbes to turn carbohydrates (biomass) into hydrocarbons (fuels). This is one of the reasons Sapphire Energy has attracted more than $100 million in investment on the concept

of green gasoline and aviation, and why Solazyme has been successful in attracting more than $100 million by deploying a diverse platform for producing drop-in aviation fuels, green diesel, green chemical and polymers and biodiesel.

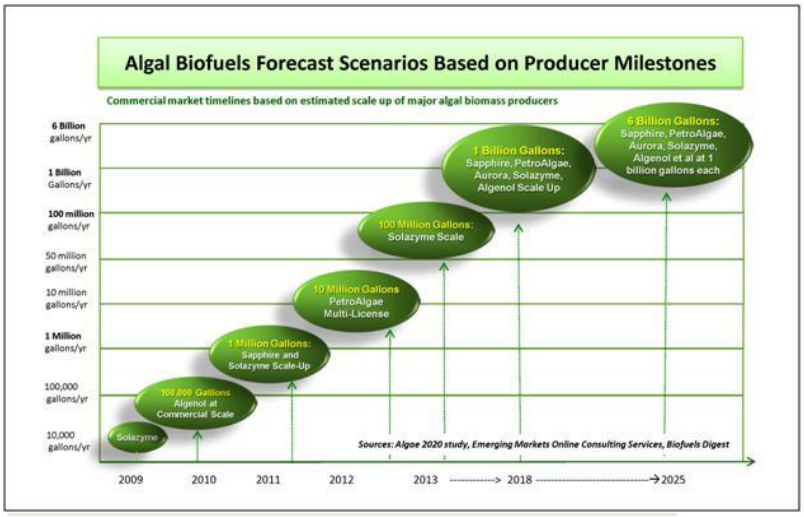
This trend also explains BP's $10 million investment in experienced algae producer Martek, and Exxon-Mobil's unprecedented $600 million collaborative R&D venture with Synthetic Genomics to create drop-in fuels and biochemical products from advanced molecular and biochemical engineering methods.

Diversification Key to Success

In a world of fast-changing regulations, there is a lot at stake in the biofuels arena. At the start of 2010, uncertain and impending sustainability criteria in the EU and U.S. first-generation biodiesel and ethanol markets are effectively limiting the growth of traditional biodiesel and ethanol markets.

The full impact of these regulations in the EU and the U.S. continues to present a major risk for first-generation biofuels stakeholders, as seen in the 2010 CARB announcement and 2009 EPA biodiesel impacts. This was highlighted in the 2008 study Biodiesel 2020, and articles in *Biofuels Digest, Forbes, Renewable Energy World, The Futurist, and Biofuels International* as a message to biodiesel and bio-refining companies to diversify feedstock inputs and fuel outputs or face the consequences of fast-changing and often unfriendly national and state government sustainability regulations.

Advanced Biofuels Investments



In the capital markets, investors have far more confidence in market demand as a measure of long-term opportunity in transport fuels and petrochemical derivatives. For this reason, the early leaders in advanced algal and microbial fuels are diversifying and targeting existing petrol, diesel and aviation markets, as well as related biofuels markets for green chemicals, polymers and power generation.

The diversification of biofuels companies beyond one fuel — ethanol and biodiesel — to include a portfolio of advanced biofuels represents a wise long-term strategy to inspire investor confidence. Over the next decade, the U.S., EU and the big

emerging markets of China, India, Brazil and Africa will demand more energy. Governments and investors are keen to see more algae producers rise to the challenge, demonstrate proof of concept, and deliver on promises for advanced biodiesel, ethanol, biojet and drop-in fuels.

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