

# ALGAE 2020:

Advanced Biofuels and Biomass Markets, Producer Profiles, and Commercialization Outlook

A new market study from biofuels consulting firm Emerging Markets Online, publisher of Biodiesel 2020 - [www.emerging-markets.com](http://www.emerging-markets.com)



# ALGAE 2020:

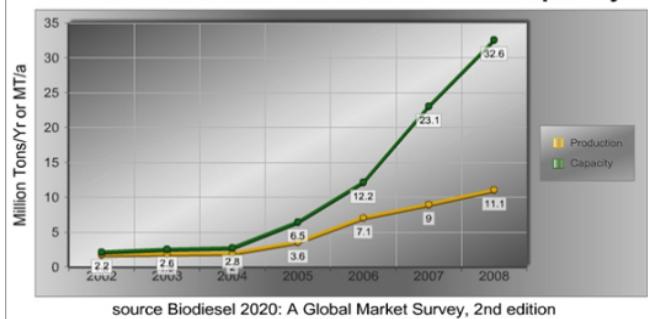
**Advanced Biofuels and Biomass Markets, Producer Profiles, and Commercialization Outlook**

## Introduction and Executive Overview

### Global Algae Market Opportunities

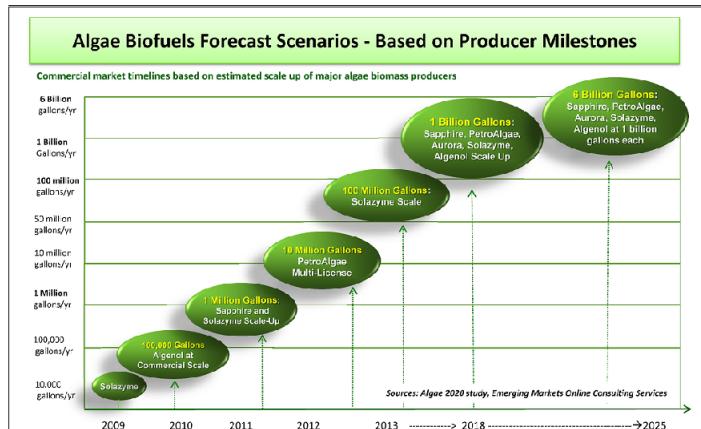
The global market for algal biomass is poised for explosive growth in the next ten years. Algae is attracting increased investment and interest from biofuels, petroleum, and agribusiness industries. *Algae 2020* finds the US and Europe can not grow enough corn, soy, or rapeseed to meet their biofuels targets. Fast growth in US and European biodiesel markets from 2007-2009 has lead to increased biorefining capacity but a shortage of feedstocks. *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 next generation biofuels.

### World Biodiesel Production and Capacity



### Algae - Feedstock of The Future

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 markets, algae strains with high oil productivity will help to bring much-needed feedstock to biorefineries world-wide.



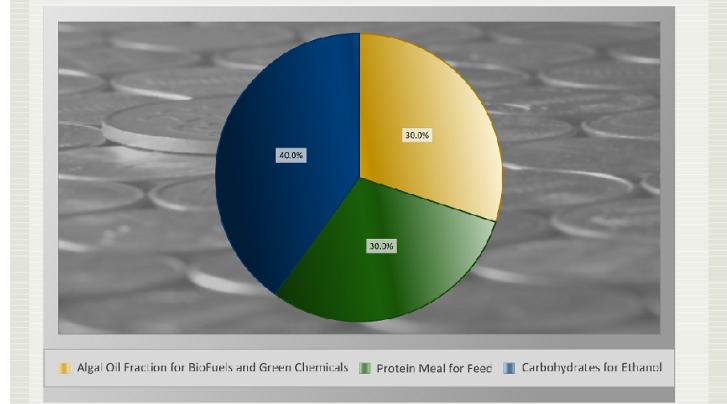
Several cellulosic biofuel scientists are now engineering advanced biofuels from algae at the microbial level by "milking the algae" to consume CO<sub>2</sub> from smoke stacks, and then secrete biofuels directly such as renewable diesel, ethanol, renewable gasoline and aviation fuel.

### Algae for Biofuels, Biomass & Biochems Markets

*Algae 2020* provides comprehensive analysis of the prospects for algae to supply emerging demands for biofuels, biochems, and biomass for livestock feed and high-value co-products. A key finding from the study reveals an increasing number of ventures are receiving investments to create algae based biocrude for petrol refineries to produce advanced drop-in fuels: renewable diesel, petrol and aviation fuel. For example, the US has invested 7 trillion dollars in its existing petroleum refining and distribution infrastructure. Drop-in fuels are a preferred source for oil and aviation companies. To supply this massive demand, several producers are working on pilot tests and demonstration projects to turn algae into biocrude as a supplement for crude oil refineries; and to create high value biomass co-products for livestock/fish feed, pharmaceutical and nutraceutical products, and green chemicals/polymers.

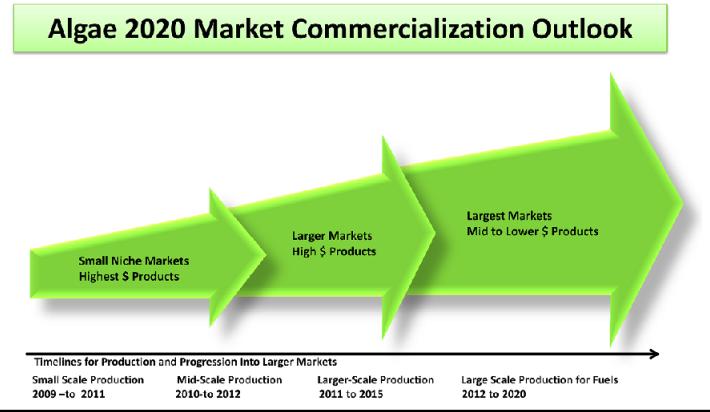
### Algal Biomass: Oil, Protein and Carbohydrate Fractions

Algae products are and will be used to manufacture: fuel, feed, food, fertilizer, plastics and green chemicals. Algae meal will be a protein supplement for aquatic and livestock/poultry feeds.



### Commercialization Strategies and Outlook

The *Algae 2020* study provides detailed profiles of the leading first-stage algae producers in pilot and demonstration projects including twelve specific business models and strategies for algae producers. The *Algae 2020* management study provides detailed market opportunity assessments for advanced drop-in fuels, high-value biomass co-products, biodiesel and biochems.



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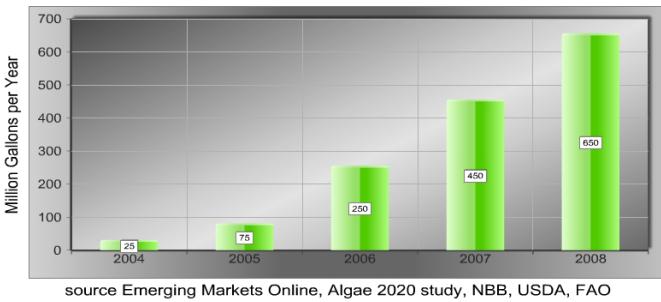
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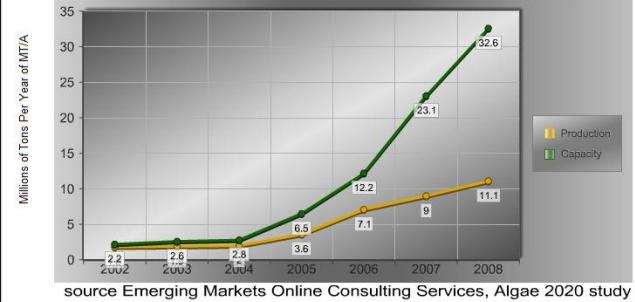
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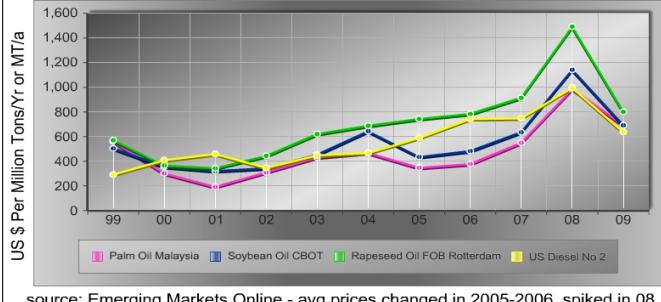
##### US Biodiesel Production 2004-2008



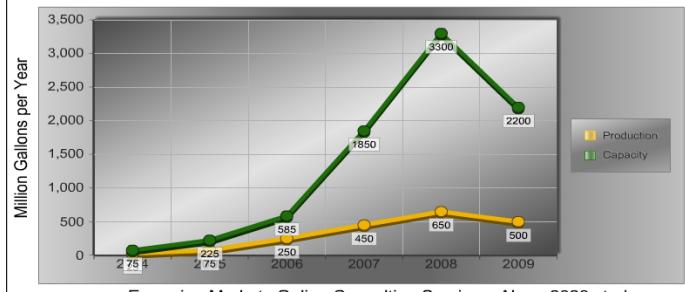
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##### Biodiesel Feedstock Prices - Palm, Soy, Rapeseed Oils vs US Diesel No 2



##### US Biodiesel Production and Capacity



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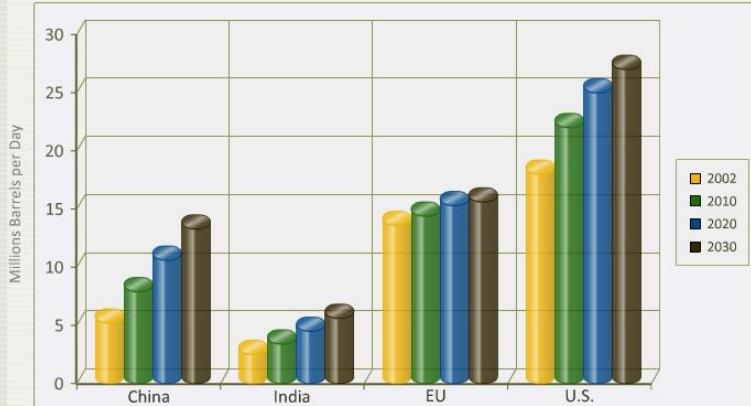
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*Target Markets for Algae Bio Crude, Drop in Fuels and Biodiesel*



Source: Algae 2020 Study, Emerging Markets Online Consulting Services, IAE, EIA forecasts

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#### ALGAE FINANCE, INVESTMENT AND GRANTS - SELECTED PROJECTS

Organization	Investment	Project Scope/R&D
Sapphire Energy	\$100 million in R&D from Bill Gates' Cascade Investments and Rockefeller Foundation	Algae for biocrude demonstration project in Las Cruces, California, and the production of renewable gasoline
Solazyme	\$75 million in R&D finance so far from private investors, Chevron	Algae for biocrude, jet fuel and biodiesel in San Francisco, California
UK Carbon Trust	\$40 million challenge for algae commercialisation by 2020	In October 2008, UK Carbon trust announced a fund to award up to \$40 million in grants for algae projects
Aurora Biofuels	Raised a second round of funding of \$20 million from Oak Investment Partners, Gabriel Venture Partners and Noventri	Aurora Biofuels is an algae-to-biodiesel startup with roots at University of California at Berkeley.
Algaelink	Undisclosed amount from KLM airlines, new Chinese ventures	New investments in the Netherlands based algae production manufacturer.
Petrosun	\$40 million in funding from China	Formation of Petrosun China, a 50/50 joint venture with Shanghai Jun Ya Yan Technology Development
NREL	\$25 million from 1970s to 1990s	Renewed investment in 2008 from Chevron, the US DOE, and several other firms.

source: Algae 2020 - Advanced Biofuels Markets and Commercialization Outlook from Emerging markets Online

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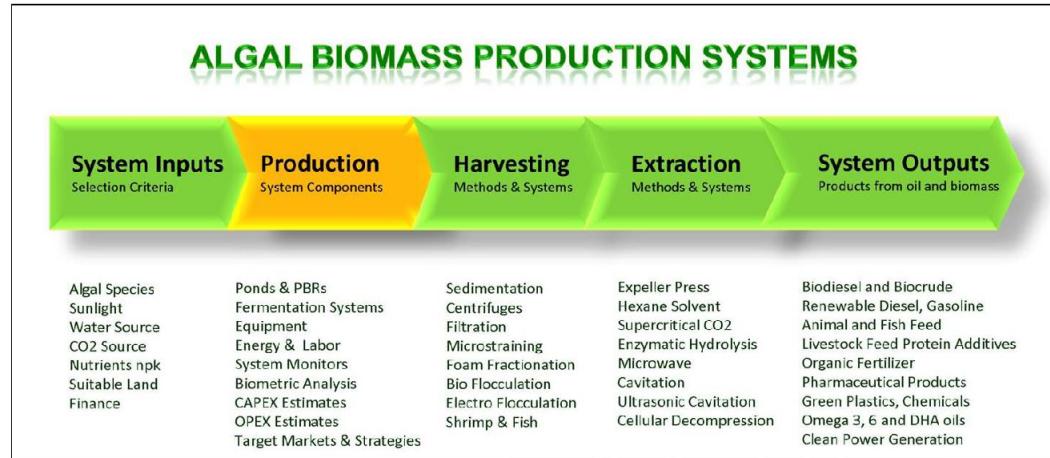
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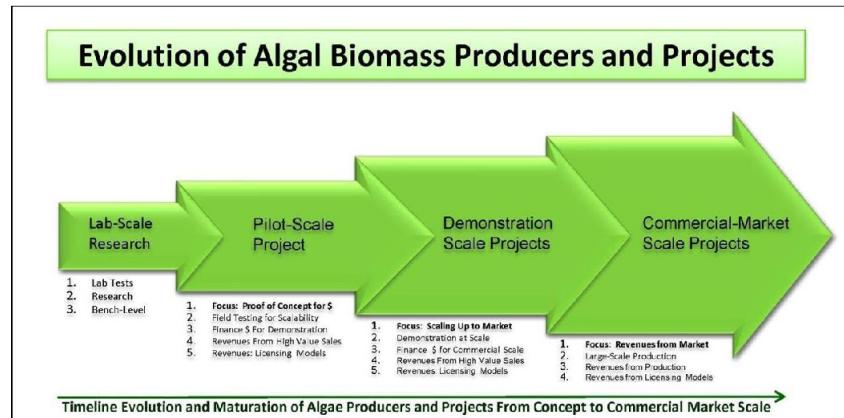
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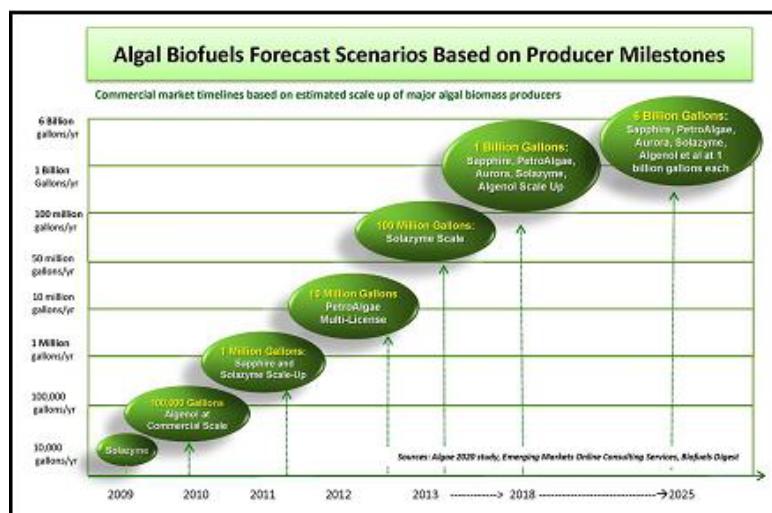
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- Algae to Energy
- Algaelink
- Algenol
- Aquaflow Bionomic
- Aquatic Energy
- Aurora Biofuels
- Blue Marble Energy
- Bodega Algae
- Cequestra
- Cellana-HR Biopetrol-Shell
- Diversified Energy
- GS CleanTech
- Live Fuels
- Origin Oil
- Petrosun Biofuels
- Petroalgae
- Phycal
- Sapphire Energy
- SeaAg
- SBAE
- Seambiotic
- Solazyme
- Solix Biofuels
- Sunrise Ridge Algae
- Texas Clean Fuels
- W2 Energy
- XI Renewables

#### Aviation/Defense-Related Profiles:

- 
- Airbus
- Air New Zealand
- Boeing
- Continental Airlines
- DARPA Consortia
- General Electric
- General Atomics
- Jetblue
- Japan Air
- KLM Airlines
- SAIC Corporation
- Virgin Airways

#### Selected Algae R&D Labs and Initiatives:

- DOE - National Renewable Energy Laboratory
- Sandia National Laboratory
- BEI - Bio Energy Initiative at Livermore Labs
- C2B2 Collaboratory - Colorado
- DARPA STO Algae Solicitations, Programs
- Hawaii Natural Energy Laboratory
- NASA Innovative Partnerships
- National Energy Technology Laboratory
- Scripps Institute of Oceanography
- Algae Collaboratory (ASU)
- Southwest Research Institute
- Los Alamos National Laboratory
- Pacific Northwest National Laboratory
- US Department of Energy SBIR/STTR Program

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