

According to the initial findings of a new research study *Algae 2020*, the algae industry is now entering the first stages of a burgeoning commercial market for biofuels

Algae investments reach €233 million in 2008

Over \$300 million (€233 million) has been invested in algae so far in 2008 including projects, initiatives and participation from Bill Gates, The Rockefellers, DoE, BP, Chevron and the UK's Carbon Trust.

The initial findings from the study identify three key trends or waves of investments now emerging in the path towards the commercialisation of the algae biofuels industry.

First wave: investment in public-private partnerships (PPPs)

The first wave of algae investment is coming from public-private partnerships between governments, universities, research labs and private companies including DARPA, NREL, and the UK's Carbon Trust.

These investments started late in 2006, and are growing in 2008 and beyond. Chevron, for example, has invested in and partnered with the National Renewable Energy Laboratory (NREL) to produce algae for biocrude, jet fuel and biodiesel.

BP has invested in PPPs with the University of California at Berkeley and Arizona State University along with DARPA to advance the use of algae for jet fuel and biofuels.

The US Department

of Energy invested \$2.3 in algae projects in 2008. Shell has invested in a PPP with Cellana, a joint venture with the Hawaiian Natural Energy Laboratory and HR Biopetroleum to produce algae for biofuels.

In late October, the UK's Carbon Trust announced the world's largest algae challenge for up to \$40 million in grants to companies that can produce commercially viable algae biofuels by the year 2020.

Second wave: direct investment in private algae companies

The second wave is direct investment in private algae companies by major investors including Bill Gates' Cascade Investments, the Rockefeller Foundation, Chevron, BP and several angel and venture capital investors. One common denominator in these investments is the potential for algae to be used as biocrude that can be

processed in large petroleum refineries or small biorefineries.

The US DoE estimates the US has invested over \$7 trillion dollars in its existing petroleum refining, pipeline and distribution infrastructure. Coincidentally, most of the largest investments in private algae companies are going to those such as Sapphire Energy and Solazyme that intend to turn algae into biocrude for petroleum refineries, jet fuel, and biodiesel factories.

Algae investments in PPPs, private companies and project finance:

Organisation	Investment	Project scope and 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
Solazyme	\$75 million in R&D finance so far from private investors	Algae for biocrude, jet fuel and biodiesel in San Francisco, California
GreenFuels	\$92 Million in project finance	Green fuels plans to produce 25,000 tonnes of algae biomass for Aurantia SA in Spain
UK Carbon Trust	\$40 million challenge for algae commercialisation by 2020	In October, 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 Noventi	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.

Investments in these private companies include a \$100 million investment by Bill Gates and the Rockefeller Foundation in Sapphire energy, and more than \$45 million invested in Solazyme in '08 by Chevron and private investors. Aurora Biofuels, an algae production company with its roots from UCal Berkeley, also received a second round of financing in 2008 worth \$20 million to fund the growth of its R&D and commercialization initiatives.

The third wave: Project finance begins for commercial algae production

The third wave of investment is seen in first-stage commercial algae project finance. Although algae has not yet been proven as a cost-competitive fuel, the cost to produce a single gallon of algae in research

labs has dropped dramatically from \$3000 per gallon in 2006, to \$250 per gallon in 2007, to between \$10 and \$20 per gallon in 2008, according to estimates from the Algae 2020 study, NREL, DARPA and industry experts.

It is important to note these cost estimates are in small-scale commercial pilot and demonstration plants. As the algae production cost curve continues to decrease, and larger scale production plants prove to be more efficient, algae will become more cost-competitive vis-à-vis petrol fuels. Scaling up these plants and their technologies remains one of the key barriers in the path towards the commercialisation of algae.

However, the economics of algae production have arrived where project finance for algae projects has reached a trigger point and several companies have now committed to

take risks and finance the advancement of larger, first-stage commercial-grade algae production plants.

For example, US based algae producer GreenFuels recently signed a \$92 million contract with Aurantia in Spain to scale up its production system to a 100 hectare algae farm by 2011 to produce 25,000 tonnes of algae biomass and in the process capture 10% of Aurantia's CO2 emissions from cement factories.

Arizona based Petrosun recently signed a contract for \$40 million in China in a 50/50 joint venture with Shanghai Jun Ya Yan Technology Development for the construction and equipment of an initial algae farm system using PetroSun's technology. In late October, Netherlands based Algaelink has recently received new investments in support of R&D efforts and contracts

to produce jet fuel for KLM airlines, and in support of new initiatives to sequester carbon dioxide from coal-fired power plants in China and the EU.

Beyond 2009

Although several challenges remain in the path towards the commercialisation of algae, an increasing number of companies now believe the rewards outweigh the risks.

With the recent election of Barak Obama in the US, and his commitment to fund \$150 billion for renewable energy projects, the Algae 2020 study predicts the trend in algae investment and project finance will continue to accelerate in 2009 and beyond.

For more information:

This article was written by Will Thurmond, president of biofuels consulting firm Emerging Markets Online, author of Biodiesel 2020 & the forthcoming study Algae 2020