ABS Energy Research

World Biofuels Report

Edition 1 - 2010

Published By

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World Biofuels Report

First Edition, 2010

This new first edition ABS report is concerned with the technologies, markets and development of global biofuel energy, both primary and secondary. The report has extensive quantified information of the world biofuel industry and market with historical profiles of major biofuel-using countries. Detailed sections of the report provide surveys of principal biofuel technologies and crops together with their usage. Environmental issues are discussed in the report, including national positions and incentives. The report also contains a valuable directory of the key market players.

Executive Summary – Overview of the market

2009 was a hard year for the biofuels sector with low oil prices and reduced demand for transport fuels. Investment was down by just over a third compared to the previous year. Plants were idle or operating at less than capacity. The industry in the EU, US, Malaysia and Indonesia were particularly feeling the effects; both the US and EU were struggling to compete with cheaper fuels from Latin America.

The projects that did receive investments mainly used mixed feedstocks and thus could adapt to changing commodity prices and supply shortages. Projects using sugar cane or next generation feedstocks such as jatropha, cellulosics or algae received significant investments. Petrobras and Amyris made the biggest investments in sugar cane. The former to produce pure and blended fuels for both the domestic and export market, and the latter to create high value products from sugar cane such as farnesene. High value products, rather than biofuels themselves, seemed to drive investment in next generation feedstocks. The three top algae developers in terms of investments have developed a range of high value products derived from algae, and two of the top three cellulosic ethanol producers have disclosed that they are developing other products. These products would provide revenue for developers in the short term before the commercialisation of next generation fuels.

Key investors in next generation biofuel projects are the oil and gas incumbents. The majority of which have covered their bases across all the next generation feedstocks. With the exception of jatropha which has performed poorly in field trials, and subsequently few investments have been made by the industry in it. BP also sold its stake in D1 Oils, a major jatropha developer, last year.

A key market for biodiesel producers is likely to be the aviation sector. In 2012 flights entering into and out of the EU have to join the emissions trading scheme. Biofuels are likely to be a part of meeting emissions targets. Other emissions and biofuel blend mandates are planned both compulsory and voluntary. To date eight test flights have been conducted using Biojet derived from petroleum and biomass blends; a further four flights are in the planning stages. Feedstocks used for Biojet include Camelina, algae, jatropha, coconut oil and babassu oil. The military has announced supply investments in biofuels, especially in fuels derived from Camelina.

ABS Intelligence: Market Highlights

Brazil is likely to overtake the US and become the biggest ethanol producer again after receiving significant foreign investments last year. The country is also investigating the feasibility of operating biorefineries in countries with duty free trade agreements with the EU and US such as Haiti and El Salvador. Elsewhere in Latin America, Argentina will continue to be strong this year and will continue

to export biodiesel to the EU until the implementation of EU sustainability criteria for biofuels. ABS feels that the industry is likely to be successful in challenging the EU's criteria for sustainability for 2010 which excludes biodiesel derived from soy beans. Producers of biodiesel from palm oil are likely to use methane capture at their plants to meet the sustainability criteria or will focus on growing domestic demand.

Following the implementation of EU anti-dumping legislation on US biodiesel imports, exports of US biodiesel has been down. While there is some evidence that producers are flouting the legislation, this is unlikely to compensate for the legislation. Accusations of the US dumping biodiesel have moved to Australia, where the government may impose emergency anti-dumping rulings in the short term. Thus, ABS believes that US biodiesel producers will not recover in the short term. US ethanol producers may also be affected by the expiration of subsidies at the end of the year, unless legislation can be passed in time.

Japan will become a growing market for the sector following the expected implementation of new biofuels legislation in the short term. China and India may also become significant biofuel markets.

ABS expects the latter part of 2010 and 2011 to be a good year for the sector, with new countries entering the sector on a commercial scale, such as the Philippines, Thailand. The EU market may contract slightly with the removal of subsidies in some key member states, e.g. the Netherlands.

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4 Energy Crops

Energy crops are potential feedstocks for commercial biofuel plants. These crops are usually fast growing with high energy content. Typical crops for ethanol include grasses such as Miscanthus and switch grass and for biodiesel include jatropha, Camelina, croton trees,

4.1.1 Jatropha

Fuel: Biodiesel
Biojet fuel

In the sub-tropics and tropics, jatropha is a very promising biofuels feedstock. It is a wild, non-edible shrub that grows on barren land, and does not compete with food crop production. Its seeds contain large amounts of oil that can be processed into biodiesel, and used as a fuel for jet engines. Extra revenue can be generated from by-products in all stages of the production process.

Table 4.1. *By-products from jatropha*

By-product	Uses
Biomass	Electricity generation and carbon credits
Curcin	Used as an experimental lung cancer treatment and aids research
Defoliant paint (from the bark)	Defoliant for submarines and makes them invisible to radars
Glycerine	Multiple (see below)
Medical spray	Skin burns
Polyol	Styrofoam substitute
Seed cake	Nutrient-rich fertiliser

Figure 4.1. *Jatropha curcas*

Source; Agriculture information.com

Table 4.2. *The advantages and disadvantages of jatropha*

Factor	Advantages	Disadvantages
Yields and productivity	Can produce 2.7 tonnes of oil per hectare	Oil yields vary considerably from year to year. Early trials in India indicate that production yields are less than expected.
	Grows for 50 years and produces oil in its second year of growth	Difficult to cultivate and harvest because it has bush-like qualities
	Can survive 3 years of drought and 600mm of rain a year	
	Oil content of its seeds range from 30 to 50% by weight and the oil content of the kernel ranges from 45 to 65%	
Costs	5 pence each per plant in Pakistan	Very labour-intensive because each fruit ripens at a different time and needs to be harvested separately
	Low input costs	
Environmental considerations	Can be grown on barren land under harsh conditions and can be cultivated as a part of the strategy for reclaiming degraded lands	Uses a lot of water in its life-cycle
	Produces a sulphourless fuel and therefore has no SO2 emissions	Potentially “weedy” and invasive to soil and other nearby plants and growth.
Other	Not grazed upon by animals	Its nuts and leaves contain toxic seeds and oil, and produce a toxic phorbol ester vapour when crushed. Special processing facilities are needed for it and careful handling.

Production of jatropha is already underway in India and China, as a way to source cheap local biofuels and increase rural development. BP invested heavily in this crop, and D1 Oils and BP started a £80 million project to cultivate jatropha on a commercial scale. In 2007, 200,000 hectares of land entered into production. China invested €253 million into building a biodiesel refinery for processing 34,000 hectares of jatropha feedstock.

Many European companies are investing heavily into small scale jatropha production in Africa. For example, Trans4mation Argi-tech, a UK-based company, recently bought 10,000 hectares in Nigeria, and CAMS Group bought 45,000 hectares for jatropha biofuels in Tanzania, in order to meet EU targets for biofuels blends in 2010.

Research into jatropha has focused on identifying high yield strains and genetic modification of jatropha crops to extend their range of distribution and increase their oil yields. In 2008, a cold-tolerant jatropha strain was identified, which may lead to large-scale jatropha production across the EU and US.

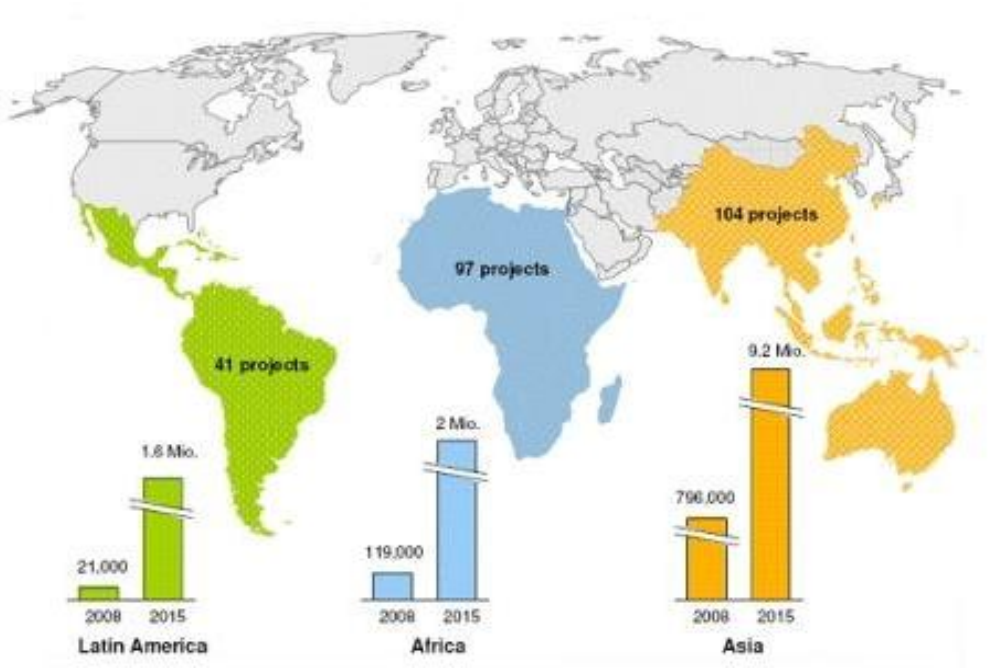

Figure 4.2. *Scale of jatropha projects (hectares) and number of projects, 2008 and 2015*

Source; GreenAir Communications

However, interest in jatropha has waned recently due to its high water footprint and lack of success in producing high oil yields from field trials. BP sold its stake in D1 oils in 2009 after a third backer for the company could not be found. Interest in the feedstock may increase following successful jet fuel test flights using fuels derived from jatropha feedstocks. Most companies in operation use multi feedstocks and produce other products either through biofuel production or from other core parts of their business.

Table 4.3. *Key companies involved in jatropha projects*

Company	Base	Other feedstocks	Planta-tions/Plants	Other products/ services	Important milestones or key information	PCT applica-tions (published in 2009 or 2010)
D1Oils	Belgium, UK	No	India, Indonesia Thailand, Malawi, Zambia	Plans for animal feed	Recently announced its intention to sell its operations BP acquired a stake in the country then sold its stake in 2009.	1 for detoxifying jatropha kernels
Eco-Fuel Global	USA	Corn for ethanol, palm	Australia, Rwanda (jatropha), Tanzania (jatropha), USA, Other countries in Africa	Facility development, environmental consultancy (includ-ing work with ports). Ethanol. Biomass for electricity (palm leaf residues). Hydro power (Tanzania)	Agreement with the Rwandan government to construct a biodiesel facility using jatropha feedstocks.	
Emami Group	India	Yes (undis-closed)	Ethiopia, India	Glycerine. Company has business interests in FMCG (fast moving consumer goods), paper and news print, writing instruments, edible oil and cultivation, bio-diesel, hospitals, contempo-rary art, pharmacy, cement, coal and power, real estate and retail	Announced that it was unable to sell biodiesel in India due to a circular from the Ministry of Petroleum effectively banning sales.	
Mission New Energy	Australia	Palm (100,000 tonne (114 million litre) biodiesel plant in Malaysia and 250,000 tonne (284 million litre) plant under construc-tion)	Australia, India (jatropha), Malaysia, Mauritius	Pharmaceutical grade glycerine and jatropha seeds. Wind energy. Research into second generation feedstocks (cellulosic ethanol and algae). Palm fatty acid distillate (PFAD) for soap industries, animal feed indus-tries, production of vitamin E and as raw materials for oleo chemical industries.	Off-take agreement with Valero for biodiesel derived from jatropha.	
Mother Earth Planta-tions	Singapore	No	Undisclosed	Potentially crude glycerol and other speciality chemicals.	Part of the asset management group, Mother Earth Investments based in Switzerland	
Nandan Biomatrix	India	No	R&D with institutions in Indonesia and	Medicinal plants. Agronomy.	Announced plans to increase amount of jatropha under	4 for jatropha

Company	Base	Other feedstocks	Planta-tions/Plants	Other products/ services	Important milestones or key information	PCT applica-tions (published in 2009 or 2010)
			Vietnam to produce jatropha hybrids		cultivation	hybrids.
Terasol Energy	USA, Brazil	Castor, Sunflower, Pongamia, Camelina, Lesquerella	Brazil (10,000 hectares of sunflower and castor crops)	Plans for speciality chemicals (undis-closed)	Acquired by the Argos Groep BV Bought Heliagro Agricultura e Pecuaria (a seed developer)	

Source; Company websites

4.1.2 Camelina

Fuel: Biodiesel
Biojet fuel

Not yet at the commercial level, Camelina is a promising feedstock for the production of biodiesel. The aviation sector has run planes on jet fuel from this feedstock and the military has signed supply contracts for fuel derived from Camelina.

The plant is native to northern Europe and the CIS region and is a member of the *Brassica-ceae* family. It's an annual plant that produces inedible seeds with 35% to 38% oil content. Traditionally this oil was used in lamp oil, now it is used in the speciality chemical industry. Camelina has two major advantages over jatropha: it is not toxic and it has more potential for cultivation. It can be grown on marginal land and requires minimal water. Plants have yields up to 1,200 kg seeds per hectare.

Planting of the crops occurs in March and harvested in late July. These crops can survive on minimal water and fertiliser, but require some crop management. A cold-resistant strain, known as Siberian oilseed, has a lot of potential because it can be grown in Northern Europe, US and Canada.

Figure 4.3. *Camelina**

**also known as gold-of-pleasure, false flax, wild flax, German sesame*
Source; Sustainable Oils

Table 4.4. *Main developers of biodiesel from Camelina*

Company	Location	Other feedstocks	By-products	Important milestones
Green Plains	USA	No	Cattle feed (selling), omega 3	Partnership with INEOS Partnership with Accelergy to mix biodiesel derived from Camelina with Accelergy's coal-to-liquid fuels Formed an agreement with the Biojet corporation to develop Camelina jet fuel
Sustainable Oils (joint venture between Green Earth Fuels and Targeted Growth)	USA	No	Cattle or swine feed (selling) Poast®, a post emergent grass control product	Contracts cultivation to farmers, has filled its quota for this harvest Supplied Camelina oil for the US Air force Flight

Source; Company websites

4.1.3 Croton trees

Fuel: Biodiesel

While Camelina might be a major feedstock in the northern regions, croton trees may be a major feedstock in countries near the equator as a substitute for jatropha. Croton trees are indigenous to East Africa and produce inedible nuts with a 32% oil content. When ripe nuts drop from the tree and can be easily collected then processed into a diesel substitute.

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