Feature

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Can biofuels recover from the crunch?

In a time of global financial crisis, can biofuels weather the storm? **David Mousdale** from beocarta Ltd provides a global perspective of the impact of the economy on the growth of biofuels.

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The downturn in US biodiesel production has been held up as proof that faith in biofuels is – yet again – proving fickle. Production soared from 2004 (less than 4 billion liters) to 2008 (over 61 billion liters) but the Department of Energy statistics then show a dramatic fall to 45 billion gallons• in 2009. 2010 figures show no evidence of recovery – and possibly even a further erosion to fall below 38 billion liters. In the recently published industry analysis, *A Quick Guide™ to Biofuels*, we identified biodiesel as a leading factor in the self-help movement by local communities; groups and individuals around the world are producing biodiesel to acceptable standards often from waste cooking oil and fats.[1] This vibrant sector of the conservation movement contrasts markedly with an ailing industry in the USA where scores of plants have ceased production; some mothballed, others definitely closed. The National Biodiesel Board pushes hard, proclaiming biodiesel to be America's first advanced biofuel but its real focus is on Congress: it will soon be 300 days since the Biodiesel Tax Credit expired. To many US critics of biofuels, the issue of incentives has re-emerged: can biofuels only prosper when subsidized by national and local taxpayers both in North America and around the globe? Put another way: going green has its financial penalties; in a slump, recession, or generally 'hard times', who will be prepared to afford the extra costs of being more environmentally concerned and active? Quite simply: clean energy costs.

In Europe, the situation is radically different. The European Biodiesel Board (www.ebb-eu.org) issued a press statement in July 2010 to announce the *continued expansion* in biodiesel production from 9 billion liters/year to over 10 billion liters/year between 2008 and 2009; in comparison, production was below 7 billion liters in 2007 and 5.5 billion liters in 2006. France and Germany remain the two principal producers but Spain quadrupled its biodiesel production between the two years and major increases were recorded for Austria, Belgium, Finland, Italy, the Netherlands, and Poland. Biodiesel formed 75% of European biofuel production where fuel ethanol production lagged (less than 4 billion liters in 2009) because of its climatic and historical dependence on expensive cereal grain and biomass feedstocks. Nevertheless, nearly 60% of European biodiesel production capacity (25 billion liters/year) remains idle. Major investments in biodiesel production commenced before 2007, driven by publicly stated and centrally directed objectives for biofuels consumption inside the European Union (EU). In addition, rising EU demand for diesel has led to an increased dependency on imports from Russia and the Middle East; this trend is expected to continue until 2030 and could undermine the security of the EU's energy supply in the coming decades. Allegations of dumping of US biodiesel via export/import movements through Canada and Singapore at less than the cost price of soybean oil have continued to sour international biofuels trade relations; the European Commission announced an investigation into this trade question in August 2010. More positively, although biodiesel blending into regular diesel is still restricted to 7%, work on the standardization of 10%

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biodiesel in Europe is continuing. The EU remains the leading biodiesel producing region with 65% of global output; extrapolations suggest that European biodiesel production could be as high as 12.5 billion liters during 2010.

There is, however, a more insidious but potentially lethal block to massive further expansion or even the full utilization of existing capacity inside the EU; we will consider this at the end of this article.

Ethanol production for transportation fuels in the USA remains – in stark contrast to biodiesel production – buoyant. The Renewable Fuels Association (RFA) (www.ethanolrfa.org) estimates that between January 2009 and January 2010 the total domestic ethanol production capacity increased by 4.4% to reach 50 billion liters/year, while the number of ethanol production sites increased by 15% and additional capacity (5.3 billion liters/year) was under construction. Ethanol production increased from 34 to 40 billion liters/yr between 2009 and 2010 (a 17.7% rise). Ethanol has averaged 9% of total gasoline demand in the USA during 2010. Demand for fuel ethanol has kept pace with production and imports have been small (approximately 0.1% of domestic production in 2010).

Another statistic illustrates a quite different aspect of US ethanol: *additional* plant capacity reached 21 billion liters/year in 2007/2008; by 2010, this had decreased to below the 2006 value (7 billion liters/year). The market limit has effectively been reached and attention is now turning back to legislation and moving beyond E10. In the words of the RFA:• 'Passage of the 2007 Energy Independence and Security Act (EISA) will help usher in the use of ethanol beyond the traditional 10% (E10) blend for conventional vehicles. With expanded ethanol use and expectations for improved vehicle fuel economy, the USA can dramatically reduce demand for gasoline and increasingly displace our need for oil and gasoline imports. Currently, the US Environmental Protection Agency (EPA) recognizes gasoline blended with 10% ethanol as an acceptable fuel for use in today's gasoline-only vehicle fleet. Likewise, nearly all automakers warranty – and some recommend – the use of E10. A September 2010 report by Ricardo, Inc., concluded moving from 10% ethanol in gasoline to 15% (E15) will mean little, if any, change on the performance of older cars and light trucks, those manufactured between 1994 and 2000.'•

Minnesota has already passed a state law requiring that ethanol comprise 20% of all gasoline sold in the state beginning in 2013. The US Department of Energy has reported results with E15 and E20 showing acceptable fuel economy (limited only by the energy density of the higher blends) with little or no effect on emissions. Intense lobbying to increase the permitted blending to 15% has continued throughout 2009 and 2010.

Biotechnology continues to define new horizons for first-generation corn ethanol. In August 2010, Lallemand Ethanol Technology (www.lallemond.com) and Xylogenics, Inc. (www.xylogenics.com) announced an ambitious program to develop and commercialize genetically enhanced yeasts for ethanol production. These enhanced yeasts will have traits necessary to further increase fermentation yield, reduce fermentation costs, and increase ethanol plant fermentation. Worldwide, research programs continue to define how to extract the maximum ethanol production from corn and cereal starch substrates, all of which are contaminated with other polysaccharides unutilized by conventional yeast strains in commercial facilities.

In the global picture, ethanol as the dominant biofuel definitely survived the financial crises of 2007/2008. Brazilian sugar ethanol is expanding; in the year to 1 September 2001, Brazilian sugarcane ethanol output increased by 22% to reach a new record (16.9 billion liters/year) and plant productivity (ethanol per tonne sugarcane) is improving (*F.O.Licht's World Ethanol and Biofuel Report*, September 2010, www.agra-net.com). The *Ethanol Producer* magazine (www.ethanolproducer.com) is equally optimistic: 'Nearly every region of the world from the United Kingdom to the Asia Pacific has begun construction or proposed new ethanol facilities. The Global Renewable Fuels Alliance reports that in 2010, 22.7 billion gallons of ethanol will be produced, a 16.2 percent increase from 2009… As in the U.S., several countries are working on mandates requiring the use of biofuels. India's government will mandate E20 use by 2011 and South Korea has decreased tariffs for materials used to produce renewable energy, not to mention the major role the Brazilian government plays in the production of Brazilian-based sugarcane ethanol… [and] most countries implementing biofuels programs are seeking energy independence, diversification and economic benefit even amidst controversy over food and land use… Ethanol demand will go up by 80 percent by 2015. Nearly 80 percent of that demand will be seen in the Western hemisphere, with the other 20 percent in Asia-Pacific.'

The oft-quoted model of '15 Brazils' being able to supply significant proportions of the global transportation market appears to be an emerging trend.[2] The above-quoted industry sources point to:

- Major investments in sugarcane ethanol production facilities in Vietnam and the Philippines.
- Inflows of foreign capital to Brazil's ethanol industry.
- In Peru, a 400 000 liters/day distillery is planned to be functional in early 2013.
- Thai ethanol exports in 2010 were 31 million liters, a fourfold rise in just one year.

Second-generation ethanol production using sugarcane residues and cereal stalks and other biomass feedstocks seriously lags expectations as an industrial reality, however, and the implementation of the US renewable fuels standard (RFS) for 80 billion liters/year of cellulosic and advanced biofuels use by 2022 is seriously threatened. As said Matt Carr, Policy Director for the Biotechnology Industry Organization was quoted by the *New York Times* in October 2009 as expecting that 2010 volumes of cellulosic ethanol 'will, optimistically, reach 12 million gallons, far short of the 100-million-gallon mandate that year. Those shortages will also ripple into later years, such that even by 2013, meeting the 1 billion gallons required will be a stretch.'

Brazil might be able to make up some of the shortfall using sugarcane residue (bagasse) and other non-food feedstocks. Ceres Inc., in California (www.ceres.net) has developed sorghum varieties to grow on land unsuitable for sugarcane production and has formed a Brazilian subsidiary to expand sweet sorghum as rival ethanol source in South America. Like sugarcane, sorghum as a plant biomass source is a leading candidate for biomass-derived ethanol production. Unlike sugarcane, however, this potential still remains to be demonstrated – as does the much less tractable issue of plant biomass, and in particular woody and herbaceous biomass – as the provider of fuel ethanol that avoids or greatly reduces land-use conflicts.

Land use and the consequences of changing land use from traditional agriculture or from marginal land to the growth of biofuels or bioenergy crops remains contentious, wherever the crop is grown and whatever biofuels technology platform using terrestrial plants is envisaged.[3] This became evident when the European Commission issued its *Communication from the Commission on the practical implementation of the EU biofuels and bioliquids sustainability scheme and on counting rules for biofuels* in June 2010. This document sets out how EU member states and the biofuels industry in Europe and elsewhere could implement the sustainability criteria and the 2009 Renewable Energy Directive's counting rules for biofuels in practice. Most importantly, guidelines for the calculation of land carbon stocks appeared in print. The focus of the EU approach and strategy is greenhouse gas emission saving: 35%, but rising to 50% in January 2017, and 60% in January 2018 (with certain provisos). Land-related criteria dictate not only that high biodiversity land must not be transferred to biofuels or bioenergy use, but also land with high carbon stocks is similarly excluded; this second category includes highly sensitive areas such as peat lands but is extended to 'continuously forested areas'. A billion tons of plant biomass from all sources (but including woody biomass) are required to substitute even a third of current US national gasoline demand.[4] The potential ambush being prepared in Europe for liquid biofuels – even cellulosic ethanol – may prove fatal, and ambitions may be forced down to the 'fuel extender' option of E10 or E15 (or B7 for biodiesel) globally. If biomass is to be grown and managed in a truly sustainable manner, ambitions for ethanol, biodiesel, and any other liquid or gaseous biofuel requiring land use• may be stringently pared down.

Ironically, biofuels may have successfully weathered the financial storms of the first decade of the twenty-first century but might never reach their potential as global energy components; environmental audits limit both land use and land-use changes – quite independently of food versus fuel issues – well before 2030.

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