Oil prices have bounced back so can the same be said for biofuels?

The road to recovery

From highs of over $140 (€106) per barrel in mid-2008, crude oil crashed to below $40 per barrel in early 2009.

Subsequently the price has shown a remarkable recovery and could now rise to $90 or higher by the end of 2010. Even more foreboding is the International Energy Agency's 2010 prediction of oil prices reaching $200 a barrel by 2035 as growth in China and elsewhere in the developing world adds hundreds of millions of vehicles to global highways. This news should significantly boost biofuels production.

As analysed in the recently published industry analysis *A Quick Guide to Biofuels*[1], the surge in historical oil prices away from the $10 per barrel that was the assumed norm in much of the second half of the 20th century has eroded the presumed dependency of biofuels production on subsidies and tax breaks.

The estimate of oil prices in the region of $50 per barrel representing the tipping point above which the costs of production of such first-generation biofuels as corn starch ethanol would be economically competitive with petrol remains unchallenged.[2]

Some biofuels did, however, take a beating during 2008. US biodiesel production was particularly badly hit. Department of Energy statistics show that production increased 15-fold from 2004 to 2008 to reach over 61 billion litres per year but then declined seriously and may be below 38 billion litres in 2010. The National Biodiesel Board continues to be bullish and pushes hard but the expiry of the Biodiesel Tax Credit remains a major obstacle to renewed optimism.

In Europe, in contrast, that forward thinking has yet to be seriously dented. The European Biodiesel Board has confirmed the continued expansion in biodiesel production from 9 billion litres/year to over 10 billion litres/year between 2008 and 2009. France and Germany are the two main producers but other European nations have ambitious programmes: Spain quadrupled its biodiesel production between the two years and Austria, Belgium, Finland, Italy, Netherlands, and Poland have all expanded biodiesel production from seed oils and other sources (including waste cooking oils). The European Union is the leading biodiesel producing and consuming region with 65% of global output.

Ethanol production from corn starch in the US remains buoyant. The Renewable Fuels Association (RFA) estimates that between January 2009 and January 2010 the total domestic ethanol production capacity increased to reach 50 billion litres/year, the number of ethanol production sites increased by 15%, and an additional capacity of over 5 billion litres/year was under construction. Ethanol has averaged 9% of total petrol demand in the US during 2010. Demand for fuel ethanol has kept pace with production and imports have been small, only 0.1% of domestic production during 2010.

Has the market limit has now been reached? In the words of the RFA: 'The 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 US can dramatically reduce demand for petrol and increasingly displace our need for oil and petrol imports.' Intense political lobbying to increase the permitted blending to 15% has continued in 2010. Minnesota has already passed a state law requiring that ethanol comprise 20% of all petrol sold in the state beginning in 2013, and the Department of Energy has reported results with E20 showing acceptable fuel economy with little or no effect on emissions.

In the global picture, ethanol as the dominant biofuel definitely did survive the financial crises of 2007-8. Brazilian sugar ethanol is expanding; in the year to 1 September 2010, Brazilian sugarcane ethanol output increased by 22% to reach a new record (16.9 billion litre/year) and plant productivity (ethanol per tonne sugarcane) is improving.

The concept of '15 Brazils' being able to supply significant proportions of the global transportation market is highly seductive and could satisfy development needs in many equatorial nations with little or no modern industry.3 Inflows of foreign capital to Brazil's ethanol industry are high, while major investments are being made in sugarcane ethanol production facilities in Vietnam, The Philippines, Peru and Thailand.

Second-generation ethanol production from nonfood plant biomass sources has – much to the disappointment of many biofuels proponents – proved disappointing.

Implementation of the US renewable fuels standard (RFS) for 80 billion litres/year of cellulosic and advanced biofuels use by 2022 is obviously and seriously threatened. The policy director for the Biotechnology Industry Organisation was quoted 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.'

BP Biofuels purchased Verenium's US cellulosic biofuels business for over $98 million in July 2010. Shell has partnered Iogen Corporation in Canada with a lignocellulosic feedstock (wheat straw) for ethanol; Iogen opened the world's first biomass-based fuel ethanol demonstration plant in 2004 and has produced 1.5 billion liters of ethanol since then.

Total has interests in biomass gasification for Fischer-Tropsch diesel, methanol and dimethyl ether, production of bio-oil through pyrolysis, and biological conversion of biomass into biofuels, and Total has ambitions for hydrotreated vegetable oil and animal fat. In other words, advanced biofuels are on their way and are now being enthusiastically developed by the world's oil supermajors but the timescale is slipping back to 2020-2040 before such biofuels could reshape the energy landscape for transportation fuels.

Brazil might be able to make up some of the shortfall using sugarcane residue (bagasse) and other nonfood feedstocks. Ceres in California 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 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 massive resources of grasses and woody and herbaceous biomass in providing future fuel ethanol needs.

Adding to this renewed euphoria is the realisation that the much-hyped ‘food versus fuel’ debate has – apparently – died down. Land statistics suggest that non-food plantations and changes in land use (especially in the tropics) could move the debate definitively away from highly charged accusations, claims and counter claims of 2005-2007.[3-5]

However, environmental issues may (highly) ironically prove to be insurmountable to massive global expansion of biofuels production. New themes in the intellectual arguments for and against biofuels began to surface during 2008, at the height of the credit-lead consumer and price boom. The most insidious conclusion was that any attempt to grow plantation-style bioenergy crops would result in precisely the opposite of the laudable goal of CO_2 abatement: land clearance for new plantings would inevitably cause a transient spike in CO_2 emissions that would require decades or centuries to overcome.[6,7] Rumors began to circulate inside the EU during 2010 of a damning report for biofuels production given this new appreciation of the perils of industrial agri- or horticulture.

On 8 November 2010, the Institute for European Environmental Policy (IEEP) confirmed that, in their view, expansion of biofuels production would inevitably cause large changes in land use and additional greenhouse gas emissions beyond those that would arise from the continued fossil fuel use.[8]

In effect, the growing of crops such as cereals for ethanol production involves the same ‘slash and burn’ approach that has been widely criticised for palm oil plantations in southeast Asia. To achieve a 10% substitution of conventional fuels by biofuels by 2020 the EU would need to convert up to an additional 7 million hectares of land to be cropped. The expansion in the area of cultivation would lead to land use change associated with significant greenhouse gas emissions as a consequence of the release of carbon locked up in soils and biomass equivalent to having up to 26 million additional vehicles on the road.

Although not considered in the IEEP report – which focused entirely on first-generation biofuels – similar conclusions could be drawn for any terrestrial bioenergy cropping. Although massive quantities of plant biomass could be sourced for advanced biofuels such as lignocellulosic ethanol, land use changes and, in particular, land clearance would rack up a CO_2 debt for future generations. Truly sustainable land management is highly problematical at the agroindustrial scale. Perhaps only coppicing (as practiced since Neolithic times could generate a supply of woody biomass without incurring the anticipated carbon debt but this would greatly restrict the provision of biomass equivalent to even a modest substitution of conventional petrofuels.

So while biofuels have successfully weathered the recent financial storm, it looks as if the longer term outlook may still be bleak.

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