

# King's Comment

## Biofuels: the route to a low carbon future?

Quarterly Bulletin from Professor Sir David King, Senior Scientific Advisor to UBS

**The unprecedented fiscal stimulus announced at this month's G20 London Summit had climate change at the heart of its agenda. Though it was, of course, primarily intended to give a shot in the arm to the faltering global economy, the agreement reached by the leaders of the world's biggest economies showed that the climate was never far from their thoughts. The recovery they sought had to be "resilient, sustainable and green", had to "accelerate the transition to a green economy" and had to help the world move towards "clean, innovative, resource efficient low carbon technologies."**

For the transport sector in particular, such technologies are urgently needed. In the EU, more than 20% of carbon dioxide emissions come from burning fuels in cars, trains, ships and planes; replacing these with low-carbon alternatives is a priority if we are to meet our climate goals.

One of the most promising approaches for cars is plug-in hybrids, a variant of the current hybrids that involves recharging batteries directly through the current electricity distribution system. However, much depends on the source of the electricity. In France, for example, only 10% of electricity is generated by burning fossil fuels, so that electrification of transport would be a very effective way to cut overall emissions. Indeed French electrified trains provide one of the lowest-carbon rapid transit systems in the world. In the UK, by contrast, nearly 80% of electricity is currently generated from fossil fuels, so that switching to electric transport would merely shift emissions from the exhaust pipe of a car to the chimney stacks of a coal-fired power plant.

Partly because of this, the EU and US have turned with enthusiasm to biofuels, which seemed at first to be a panacea. The idea was to generate fuels from plant material rather than coal, oil or gas. Carbon dioxide that plants soak up from the atmosphere in their growing season is merely returned to the air a little while later when the fuel is burned, so that in principle such fuels should be more or less carbon neutral.

However, the devil is in the details. The first problem with biofuels is that they don't necessarily do what they say on the tin. Though the fuels themselves are carbon neutral, their processing is not. Sowing, tending, harvesting and then converting the plants into fuel requires energy and fertilizer, both of which produce significant greenhouse gas emissions.

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In the final equation some biofuels, such as Brazil's sugar cane alcohol, still come out fairly well compared to fossil fuels. But others, notably the corn-based fuel favoured in the US, can be almost as bad as the petrol they seek to replace. Much of the biodiesel imported into the EU from countries such as Indonesia suffers from the same problem. In this case, the rainforests that are cut down and burned to clear the land for planting can cause more emissions than the fuels themselves save.

Then there's the notorious effect of such "first generation" food-based fuels on the supply of food, and hence its price. A World Bank report attributed fully 75% of last year's spike in food prices to the surge in demand for biofuels. Moreover, because of the rising global population, food demand over the next two decades is predicted to increase by 50%, making first generation biofuels an even more foolish idea.

This is not to suggest that all biofuels are bad. However, we will need to be much more careful about how we make them. The smart money is now on second generation biofuels, created either from crop residues such as stalks, leaves and husks, or from crops planted on marginal land that do not compete with food.

Converting crop residues into effective fuels is not easy – by their nature such residues are hard to digest and resistant to chemical transformation. Current approaches involve either a biological route using bacteria or enzymes to make the transformation, or a physical route using industrial catalysts. Although neither of these routes is yet competitive economically, both show great promise. (The research teams I am working with at Oxford and Cambridge universities are developing a system for producing petrol or kerosene from bi-products of food crops and general waste.)<sup>1</sup> Indeed the kerosene used today to fuel jets at Johannesburg airport was formed synthetically via catalysts. Unfortunately the feedstock for this was coal, which gives it a very high carbon footprint. But if we can make synthetic jet fuel from coal, we can certainly do it from leaves and stalks and trees.

Feedstocks that can grow on marginal land such as switchgrass (for bioethanol) and jatropha (for biodiesel) also look promising. These come with the additional benefit that they could provide tremendous opportunities for developing countries that are already suffering disproportionately from climate change.

Such second generation biofuels will not solve the whole transportation problem. Electric vehicles will become increasingly important as countries reduce the carbon footprint of their electricity grids by turning to options such as renewables and nuclear. However, done right, biofuels will still make a significant contribution.

As for the timescale on which we can expect second generation biofuels, much depends on investment levels. Now that we are beginning to have a price on carbon's head, many companies have recognized the opportunity afforded by low-carbon alternatives. The current price of carbon has faltered as a result of the financial crisis and consequent recession; less carbon dioxide has been produced than anticipated so prices have obviously gone down. However, when the global economy recovers the price of carbon will rise concomitantly.

BP has funded a major research centre into second-generation biofuels in Berkeley, California. (Incidentally, this was headed by Steve Chu – before he was co-opted to be President Obama's new energy secretary.) Shell, meanwhile, has a large research effort based in Canada. Given the current levels of investment I would expect second generation biofuels to be available in the next 5-10 years.

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1. Sir David King is Director of Research in the Department of Chemistry at Cambridge University and Director of the Smith School of Enterprise and the Environment at Oxford University. See further 'Quo Vadis Biofuels?' Energy Environ. Sci. 2009, Vol 2, pp 343 - 346.

I would also expect investments in second generation biofuels to rise as further climate commitments begin to bite. Governments across Europe have committed themselves to emissions reductions of 80% by 2050. Obama's new administration has pledged to follow suit.

Moreover, the G20 leaders at the London Summit finished their statement thus: "We reaffirm our commitment to address the threat of irreversible climate change, based on the principle of common but differentiated responsibilities, and to reach agreement at the UN Climate Change conference in Copenhagen in December 2009."

In other words, we know very clearly where the market is taking us. Low carbon is the energy of the future, and that is where the wise investments will take place today.

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In April 2008, UBS announced the appointment of Professor Sir David King as our Senior Scientific Advisor. Formerly the UK Government's Chief Scientific Advisor and Head of the Government Office for Science, Sir David advises UBS on all scientific matters with particular emphasis on global climate change and the challenges it poses to sustainable economic growth. He is also currently Director of the Smith School of Enterprise and the Environment at the University of Oxford.

'Biofuels: the route to a low carbon future?' is the second of 'King's Comment', a quarterly series of science-focused bulletins by Sir David King. Visit [www.ubs.com/sirdavidking](http://www.ubs.com/sirdavidking) to learn more.



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