



## **Cars, Planes or Trains? Biofuel – Food or Fuel?**

**8<sup>th</sup> February 2007**

The Cambridge Energy Forum event was organised around the broad theme of transport, and implications of climate change including the energy and fuel mix for different transportation mechanisms.

Professor Roger Kemp of the University of Lancaster led the presentations with a broad ranging discussion of the different modes of (personal) transport available to the UK, noting that overall differences in efficiencies of various modes are dwarfed by the variation caused by differences in load factors, and secondary 'indirect' energy system impacts.

He started by noting the significant economic, social and political capital invested in different forms of transport systems, coupled with a comment on the popular media tendency to polarise debate when discussing such systems. Since the 1970's, the UK carbon footprint of transport activity has been steadily increasing year on year, whereas to meet our climate change goals we are going to have reduce that carbon footprint at twice the rate over a similar period. The implications for UK citizens are significant, with many questions still unanswered; do we wait for global consensus, do we go down the contract and convergence route, do we insist on low-carbon electricity (non-mineral) to reserve fossil fuels for transport?

There are basically four routes to reducing the energy used by transport systems:

1. Increase the efficiency of existing transport systems not merely by 10%, but radically.
2. Reduce the amount of personal travel – a politically unpalatable option.
3. Encourage modal shifts from high consumption to low consumption modes of transport.
4. Ensure transport systems are powered by low-carbon energy sources.

Referencing the modal shift to the high speed TGV in France, powered largely by (low carbon) nuclear power, would this work in Britain with fewer low carbon

resources, and what of in the increased energy demands from high speed trains? Even if a low carbon energy source is used, is it best used for transport, or would it better be used to displace energy that would otherwise come from high-carbon sources? One way to think of the implications would be to say 'remove the transport system' from the UK's energy system – which power plants or sources of fossil fuel would shut-down?

Comparing the different types of train engine one can determine that they broadly fit in the 0.3-0.5 kwh per passenger kilometre range with electric engines tending to be more efficient than diesel, and the impact of privatisation shifting purchasing to faster less efficient stock. Going forward ten years, as the UK electricity supply is 'de-carbonised' these differences will amplify, with the resultant implication that the Department of Transport should instigate some form of rail electrification programme (none currently exists).

In discussing load factors for different modes of transport Roger neatly showed the different assumptions one could use in relation to the typical parent / child school run (is the parent part of the transport system?), then referenced the typical load factors for the two main types of 'public' transport – buses and trains. It is quite feasible to see situations where a journey by private car would be a preferential to a journey by train or bus (albeit in a minority of cases).

In noting the differences between ground base transport and aviation, the issue of radiative forcing (the multiplying of the impacts of CO2 emissions into Tropopausal altitudes, combined with con-trail / vapour trails acting as multipliers to the greenhouse effect) and the difficulties of ascribing a given factor to different altitudes and plane types were discussed.

Roger then proposed a variety of scenarios where the 'obvious' answer was beset by questions relating to secondary impacts – a ferry to Scandinavia, various ways of travelling to Hyderabad, commuting between Edinburgh and London.

In conclusion travelling by anything other than bicycle or foot, has undesirable environmental impacts, one of the most important implications from studying those impacts at anything above the most simplistic of levels, is that it is more important to travel in full vehicle than which mode of transport one chooses. Aviation always has negative environmental impacts, but other modes can be just as bad if not managed properly.

Our second speaker for the evening, Simon Harris of Lysanda a Cambridge based start-up, started with a history of road taxation in the UK, from the turnpike riots mimicking today's million person petition against road charging, through to the establishment of the 'per vehicle' tax, whose current incarnation is the Vehicle Excise Duty (VED). He then noted the irrelevance of the current VED variations according to average emissions, given the costs of running the vehicle.

In relation to EU road toll schemes, and the London Congestion Charge systems he noted the inaccuracy and significant embedded costs of such systems.

The Lysanda solution to the brutishness of current road taxation systems is to move toward a 'pay as you pollute' system, and his company has developed an innovative technology that allows for real time collation of emissions data, linking to the new Galileo satellite system sponsored by the EU.

Rather than relying on in-exhaust sensors, the Lysanda system integrates with the engine management system, to provide accurate real-time information to interested parties; fleet managers are able to reduce operating costs by instigating incentives for fuel efficient driving, drivers have real time feedback so that they can develop 'light right foot' driving, and political authorities can move toward taxing 'bads' such as environmentally damaging emissions, rather than 'goods' such as economically advantageous transport.

Such a system could replace expensive camera based congestion charging systems.

Our third speaker Dr Gail Smith of Unilever, who discussed first generation biofuels and some of the environmental and economic issues of agricultural systems involved in their production. Biofuels are not new, though they have risen to prominence recently owing to political and environmental pressures, coupled with rising oil prices. There are three main drivers to this new surge of interest each of which stir political and emotional issues ;

1. Climate change and carbon issues,
2. Energy Security concerns,
3. Rural economic revival.

A naïve perspective on biofuels, is that they are innately sustainable, however in studying the various feedstocks, one must take into account a number of issues; firstly the energy involved during production, and resultant greenhouse gas impacts (N<sub>2</sub>O is especially important in agricultural systems); and issues related to water use and biodiversity. There are significant implications for governments, as the agricultural systems adapt and in turn impact the food supply chain. Biofuel is essentially a liquid fuel competitor to mineral derived oils, whose supply chain is complex; and whose participants are wont to shift the burden of action onto the other parties in that supply chain.

For a farmer, with the variable inputs of sunshine and water, the energy inputs and fertilizer requirements for different biofuel feedstocks, which typically do not need irrigation, need to be assessed, together with the resultant financial benefits from sales of not only the biofuel but also the co-products (meal in the case of oil seed rape, and fibre for sugarcane) coupled with biomass that can be returned to the soil, or incinerated. If one does the calculations, then different feedstocks

have different greenhouse gas benefits compared to their mineral oil equivalents – 60-70% for oil seed rape, 80% for sugarcane, some studies in the US have suggested that there is no net benefit from corn derived biofuel.

Life cycle analysis studies have been applied, with some difficulty, to agricultural systems with mixed results. Another issue aside from crop type is considering the use of productive and non-productive land (such as conversion from pasture, scrub or cerrado), or indeed the clear felling of rainforest (a carbon sink) to make way for biofuel plantations.

Studies comparing the importation of vegetable oil to Rotterdam for margarine production, discovered that importing oil in large tankers from South East Asia, is actually more energy efficient than rape oil that had been transported from Germany, which is a counterintuitive finding. Whilst second generation biofuels (cellulosic) are being promoted as solving many of the above complexities of first generation biofuel production, the honest answer at the moment is that we don't know if they will be a better solution.

Dr Smith then showed data from WWF relating to the palm plantations that have evolved and are predicted to evolve overtime on the island of Borneo – shared between the nations of Malaysia and Indonesia. Since 1950, there has been a staggering loss of rainforest given over to palm oil plantations. When the clear-felling and plantation construction were initiated they were justified by economic models that suggested the increased palm oil output would be consumed by the growing populations of the tiger economies who would wish to eat more carbohydrate as their economic condition improved, it was assumed that domestic production and consumption would balance. In fact, domestic consumption has gone down, EU imports have stayed the same, with India and China importing the remainder of the increased production (to improve the diet of their populations).

In relation to say 10% of EU transport fuel being derived from biofuels, this would currently require around 52% of EU agricultural land being devoted to energy crops, with similar percentages in the US. Even factoring in assumed productivity improvements, there is simply not enough land to cater for both food and fuel production at current rates of fuel consumption.

The issues surrounding the 'sustainable' use of biofuels, and the resultant competition with food sectors, coupled with the fact that some of the poorest populations in the world derive up to 25% of their calorific intake from biofuel feedstocks, perhaps highlight the complexities of this area. Unilever has led the establishment of the 'Roundtable on Sustainable Palm Oil' to help work through these complexities in an equitable way. Much of the support for this has come from the EU, who by themselves don't have enough influence, whilst China and India are prioritising economic growth. In both the EU and US different lobbies are advocating second generation biofuels, thought to what extent this will then

involve subsidised support for the farm sectors, or the encouragement of genetically modified feedstocks, and the resultant societal implications, with one set of technologies becoming entrenched, are all issues for debate.

A wide ranging debate followed, touching upon the likely impact on food prices, WTO negotiations, the need to remove subsidies from the Energy, Transport, and Food sectors, and the need for economic models to evolve to better reflect the physical, environmental and social realities of living in a carbon constrained world. The main take-away from the evening was that there are no simple answers, that often counter-intuitive answers apply to situations, and that we need to work through the specifics, as well as secondary impacts before coming to conclusions. One member of the forum noted the irony of returning by trans-atlantic plane from a climate conference, where the in-flight movie was Al Gore's 'Inconvenient Truth'.