

Biofuels – Cutting CO₂ Emissions in Transport

By Jeff Rees

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Biofuels are certainly part of the solution to cutting CO₂ emissions in transport, the more difficult prediction is which ones will be used and how large a part will they play. Transport is a highly competitive, low margin, short term, cost focussed market and whilst we can understand the environmental arguments, operators will also be looking to win transport contracts by being competitive on price. Many alternative fuels are currently more expensive to produce than diesel but this imbalance is and will be further addressed by carbon taxes, new technology and development grants for alternative fuels. There is also a responsibility on the large transport users such as FMCG manufacturers and retailers to include environmental targets when setting up new transport contracts.

Increase in efficiency

Before jumping straight in and looking at biofuels let's briefly cover the broader question of cutting CO₂ emissions in transport. The starting point for most companies must be to reduce CO₂ emissions by making their transport operations more efficient. The beauty of these improvements is that the economic and environmental benefits are proportional and totally complimentary to each other. Every £1,000 of fuel saved by transport efficiency puts 2.6 tonnes less CO₂ into the atmosphere. The techniques for achieving this start from improvements in the supply chain design and strategy, through vehicle route planning and optimisation, vehicle technologies such as aerodynamics and telematics, to measurement techniques and training.

Electric Vehicles

Electric vehicles should also be considered. As a general principle it's more efficient to produce energy in a power station and charge an electric vehicle than it is to burn diesel in a road vehicle. Whilst trains running on electrified lines make full use of this benefit, road vehicles are dependant on battery technology, which limits the speed and range of the vehicle and increases weight. Currently this limits the use of these vehicles mostly to the urban environment. It should also be considered that if the electricity can be produced from renewable sources such as wind or nuclear there are no CO₂ emissions. Clearly there

are other environmental implications to consider with this approach, particularly with the use of nuclear power.

Other Transport Modes

Modal changes should also be considered. Using a general environmental ranking, air is most damaging to the environment, then road, rail and water and within each of these modes the larger the vehicle (greater load capacity) the lower the amount of CO₂ produced per tonne kilometre (one tonne being moved one kilometre) travelled. The greatest amount of CO₂ per tonne kilometre being produced by a short haul aircraft, and the least by a large sea vessel. There are of course currently many constraints when using other transport modes such as time taken, the infrastructure required and the necessity to also use road to reach many destinations (multi modal transport).

The overriding factor in all of these areas is the most efficient use of available fuel sources is paramount whether its fossil fuels, electricity or biofuels. Each of the concepts above has its part to play in reducing CO₂ in transport, as does the use of biofuels.

Biofuels

One of the benefits for biofuels is that many are currently available and can be used in most modern engines with little or no modifications. Most are compatible with fossil fuels and are used as a blend or mix of fossil and bio fuels. Biodiesel is compatible with diesel, bioethanol is compatible with petrol and biogas, being methane based is compatible with natural gas.

Liquid Biofuels

Lets first look at the liquid biofuels. Biodiesel is produced from plants such as rapeseed, sunflower, soyabean and palm oils. Bioethanol is produced from starch, sugar or cellulose crops such as wheat or sugar beet. The great benefit of these fuels is that they absorb CO₂ from the atmosphere during their growing cycle potentially giving a very positive net CO₂ effect (60% to 70% less compared to diesel) when the total life cycle is considered.

If we look just at the usage of these fuels, we see they are widely used. In Brazil 45% of car fuel is bioethanol (used blended with petrol) and 6 million cars in the USA use a 15% bioethanol blend of fuel.

Practically all engine manufacturers will guarantee their engines to be used with a 5% blend of biodiesel or bioethanol and some manufacturers guarantee up to 30% with no engine modifications. These biofuels are starting to be used in the UK and there are 165 biodiesel and 16 bioethanol refuelling stations around the country. Typically the blend will be only 5% biofuel to enable it to be used in all vehicles giving a 3% reduction in CO₂. Whilst this is a long way from solving the global warming problem it is a start.

If the argument for biofuels were as straightforward as described above further use and implementation would only be a matter of time. Not surprisingly there are many other factors to take into consideration.

If biofuel crops are simply replacing an existing food crop (that absorbed CO₂) the benefit of absorbing CO₂ from the atmosphere is not realised. Worst still this can increase food prices and create shortages as has been seen with a tortilla shortage in Mexico as a result of the USA growing more biofuels. The total carbon life cycle analysis for biofuels also needs to take account of farming and production techniques. Some crops require high levels of nutrients in the soil leading to the use of fertilisers (depending on soil), which require energy to be produced. Processing of the fuels can also require high energy levels, which again need to be taken into account in the total carbon life cycle.

The other much-publicised problem with growing biofuels is the clearing of rainforest to make way for the farmland and plantations. This clearly has a further negative environmental effect not only on CO₂ but also on the total ecosystems and species in the area. The palm oil industry has already set up 6.5 million hectares of plantations in Sumatra and Borneo and has removed an estimated 10 million hectares (an area larger than Ireland) of rainforest for the development.

Most studies show that biofuels cannot totally replace fossil fuels as there are not the land areas available to support both the biofuel crops and food production. Biofuels can therefore only be a part of the solution.

Many of the drawbacks can however be addressed and the key to biofuel production is that it has to be sustainable. Large scale biofuel production may have challenges competing for land in developed areas like Western Europe or in forested regions, but there are many developing countries that have spare agricultural capacity with the climate and land profiles that suit the production of biofuels without having to resort to forest clearances or reliance on manufactured fertilisers. In these cases the production of

biofuels also develops the local economies. In all cases the sustainability of the growing, farming and production techniques need to be fully evaluated and controlled.

To address many of these issues the production techniques for a second generation of biofuel crops are being developed. Crops include forestry waste, tall grasses, fast growing coppice willows and even algae that can be grown in salt water.

Biogas

Biogas should also not be forgotten. The potential benefits of this fuel are enormous, having 95% less CO₂ and 80% less nitric oxides than diesel and zero particle emissions. The raw materials for the production of Biogas are readily available. Rotting municipal and food waste, human and animal sewage can all be used. The most common form of production is by putting the waste into a digester (a large container) and processing the methane gas emitted. This methane is itself a greenhouse gas and would normally be released into the atmosphere. Capturing and burning it therefore has the added benefit of removing this harmful gas from the atmosphere. Biogas is manufactured to the same specification as natural gas and is therefore fully compatible.

Sweden is currently developing biogas production facilities and has about 7,000 vehicles on the road with plans for 80,000 vehicles by 2010. The UK currently has no biogas refuelling stations available and only 18 natural gas stations available. It is however estimated that there is enough biogas available in the UK to fuel half of the HGV fleet.

Conclusions

Biofuels like many other techniques and technologies have their part to play in cutting CO₂ emissions in transport. Some are currently available, some are being widely used in other parts of the world but all need to be developed to be sustainable and used efficiently. In the longer term more road vehicles may run using electricity or hydrogen fuel cells that have been produced from a renewable electricity source like wind, water, solar, tidal and nuclear power. All of these technologies also have their limitations and drawbacks so the continued development and implementation of sustainable biofuels is currently part of the solution of reducing our carbon emissions. The current global targets of 25% to 40% reduction in greenhouse gases by 2020 are being discussed to stabilise the percentage of greenhouse gases in the atmosphere and stop the rise in global warming. It's therefore clear that all available techniques and technologies need to be fully assessed and utilised.

Whether one technology will provide a global transport solution in the same way as oil has for the past 100 years has yet to be determined.

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