

What Future for Biofuels?

Has the Tide Turned?



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Executive Summary

Biofuels have gone from being the great hope for clean transport fuels of the future to being in the dock accused of causing deforestation and increases in food prices for the world's poorest people. Against this context, the UK Gallagher Review of the indirect effects of biofuels production¹ has delivered a sober and timely assessment of the industry and its future. The Review examines the difficulties of assessing the social and environmental impact of biofuels, and sensibly recommends a cautious scaling back of future biofuels targets.

We believe that the Review could lead to a fundamental change in the biofuels industry through changes in the way it is regulated, not just in the UK but worldwide. In particular, whilst there is still no exhaustive consensus view on the sustainability of particular biofuels, businesses that produce or use them need to form a pragmatic view right now on how they will respond to this challenge. In this report we set out the implications of the report and outline what the industry and Governments need to do to secure a future for biofuels.

¹The Gallagher Review of the indirect effects of biofuels production. Renewable Fuels Agency Publication, July 2008

What Does the Gallagher Review Recommend?

The Gallagher Review of the indirect effects of biofuels production, published in July 2008, provides a very clear assessment of the current state of the biofuels industry and its potential. It calls for 'more caution and discrimination' and explicitly says that 'the introduction of biofuels should be significantly slowed' in order to reduce its land displacement effects and impact on food prices.

The Review concludes that it should be possible to develop a sustainable biofuels industry by implementing comprehensive sustainability standards and encouraging new technologies and new approaches. However, it says that achieving this position will take time.

Although a formal public consultation will take place before reaching a final decision, we believe that the UK Government will pay heed to the Review. Equally, given the UK's position as one of the leading thinkers about biofuel sustainability, we think it will have a broader international impact, in the EU and beyond. That means there are likely to be changes in policy across the world, not least in the Renewable Energy Directive.

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Biofuels in a nutshell

Biofuels are renewable transport fuels produced from biomass (mostly from plants). They are usually in liquid form, and can be blended with fossil fuels at low concentrations without the need to change vehicle engines or fuel infrastructure. Bioethanol and biodiesel are the current mainstream biofuels:

- **Bioethanol** is made from grain and sugar crops and is a substitute for petrol.
- **Biodiesel** is made from vegetable oil and is a substitute for diesel.

A wide range of crop feedstocks and manufacturing processes are used to make biofuels. A common theme is that the bioethanol and biodiesel which is produced commercially at present generally uses arable food crops such as grain and sugar cane. These are typically referred to as as "**first generation**" biofuels.

There is also a huge range of "**second generation**" manufacturing processes under development which are able to convert woody biomass into biodiesel and bioethanol. These processes remain a long way from commercial reality but will potentially be able to use waste biomass materials such as straw and forestry by-products to produce transport fuel.

Both first and second generation processes can also be used to produce a range of other liquid fuels such as biobutanol and synthetic gasoline. Many of these have improved fuel properties and energy content, but in some cases they require more radical changes to fuel infrastructure.

Finally, "**algal biofuels**" are extracted from oil-producing microalgae. Again, a wide range of possible processes exist for doing this, but large-scale production of algal biofuels is likely to become possible several years after large-scale second generation production.

What Kind of Biofuels are Best?

One of the key challenges for the industry is that it uses such a wide variety of production processes and feedstocks and each of these have different environmental, social and economic impacts. There is no consensus view on how to assess these impacts and no consensus view on which biofuels are acceptable from a business, food and wider environmental perspective. Policy makers will need to develop that view, but investors and the industry cannot afford to wait for that position to emerge: they must make their own pragmatic judgements now.

Our assessment of biodiesel, when it is produced from feedstock other than waste oil and animal tallow, is an unfavourable one because:

Biodiesel is leading to substantial increases in oil seed prices – Biodiesel is responsible for a significant fraction (between 6 and 7%) of the demand for bulk vegetable oils. However, oil seed crop yields per hectare have not risen in line with increases in demand and, as a result, prices have increased.

Prices for feedstock will remain high – Since vegetable oil prices have increased in response to high demand, this price increase is likely to continue. This is in contrast to grain prices, where recent increases are driven more by supply issues caused by poor harvests. As a result, the biodiesel industry will continue to face real cost challenges as its feedstock prices remain at a premium.

Biodiesel is changing land use – An increase in the amount of oil crops grown for biodiesel production is likely to cause indirect, and possibly direct, changes in land use. The prices of different oil crops are closely linked, so increased biodiesel production will almost certainly lead to increased cultivation of palm oil. The environmental effects of any resultant rainforest clearance are so dramatic that, even with some uncertainty as to the scale of the effect, the precautionary principle must be invoked.

All these factors mean that we expect growth in the biodiesel industry to decline rapidly, especially in countries that follow the lead of the Gallagher Review. In fact, we have already seen this movement in the UK and Germany as a result of high feedstock prices and changes in political incentives. Since government incentives are the deciding factor in making biofuels cost-comparable with petrochemical alternatives, government action could reduce biodiesel production very quickly.

In contrast, for bioethanol, growth is likely to continue in the short term. This is partly due to political momentum in favour of ethanol produced from grain, and especially in the US.

However, the picture on bioethanol is not entirely favourable due to:

Increases in grain prices – Increased grain prices are hurting the biofuels industry and although the effect has probably been smaller to date than that of biodiesel – to some extent because demand so far has been met through the use of existing agricultural surpluses – bioethanol shares some of the blame for these increases.

Competition with food – Bioethanol will increasingly compete directly with food for grain supply as uptake increases. It may also cause indirect land use change, though this is difficult to measure and, as they have done in the past, farmers may be able to increase yields in response to demand. It will be blamed for food price rises and their negative impacts, turning public opinion against it.

Inefficiencies in fuel production and use – The energy balance of many ethanol-producing processes is not good, lowering the environmental benefits of the fuel and hurting its commercial viability. Its energy content is also a third lower than that of petrol, lowering its efficiency as a fuel.

How Should Industry Respond?

These factors mean that companies and investors with interests in the biofuels sector need to respond to two primary challenges.

The first is *proactively to develop a framework for assessing the sustainability of their products and investment portfolios*. Those companies that produce this kind of assessment will be able to lead the debate. They will be sufficiently ahead of the game to adjust their feedstock sourcing, and anticipate and influence the requirements of policy makers for sustainability.

In lieu of *exhaustive* research, such a framework needs above all to be pragmatic and workable. It should exploit the available evidence, alongside new research, where necessary, to reach a useful and robust position. This will involve, at least, consideration of the fuel's lifecycle GHG emissions; and will seek to minimise both competition with food crops, potential land use change, and other impacts of agricultural intensification such as the scale of requirement for fresh water and nitrogen-based fertilisers, which bring further environmental issues.

Secondly, the industry needs to *consider its future structure and develop a technology strategy to respond*. There is scope for a whole new generation of fuel molecules which may supersede bioethanol and biodiesel and better meet future needs. But there are many challenges: to overcome the technological barriers; to determine which can be made commercially viable; and to establish which forms will be best able to meet future sustainability requirements.

This future industry, informed by the Gallagher Review, is likely to take advantage of two particular opportunities:

The emergence of a new generation of fuel molecules with a higher energy content – Novel fuels like biobutanol and synthetic gasoline are yet to be produced at commercial scale but offer better performance than bioethanol. They will also have low barriers to market entry since they are compatible with existing fuel distribution and transport infrastructure.

The opportunity is clear and leading companies and investors will need to: invest in these products; form the right strategic alliances; and establish a balanced portfolio of investments. If they do not seize these opportunities now, they risk finding themselves competing against better and more sustainable products offered by smaller, nimbler companies and their industry backers. Many companies – including the oil majors such as BP – are already thinking along these lines.

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The emergence of technologies that can make use of a wider range of bio-based feedstocks. Another development that could cause upheaval in the entire industry could come from using new types of feedstock such as municipal solid waste, agricultural arisings and forestry products.

The “second generation” technologies required to do this remain a long way from being commercialised and, while there is considerable potential, it is not yet clear which technological route is likely to prove successful. For example, large process companies have developed thermochemical routes to convert woody biomass into liquid fuel, but it may prove difficult for them to achieve a good balance between the amount of energy required to produce the fuel relative to the amount released when it is used. The alternative of enzymatic approaches or those using oil-producing algae (which do not compete for arable land), may prove more effective. However, they too face problems, with enzymes being less suited to processing with heterogeneous feedstocks and high levels of impurities.

What Do Governments Need To Do?

Governments have an essential role to play in the future of the biofuels industry in the next decade, and need to put policies in place quickly. Where the commercial case is unclear, fiscal and regulatory frameworks will influence business strategy to a great degree. The Gallagher Review is very welcome, providing a clear direction and a greater degree of realism about the timescales for future commercialisation of new biofuels.

We hope governments will act on the Review. It will be 7 or more years before second generation biofuels can provide more than a fraction of one percent of the overall supply of fuel. In the interim, they need to be encouraged with supportive yet realistic policy and subsidy frameworks. And businesses need confidence that these frameworks will persist well up to 2020.

In particular, governments can have a role in developing the assessment frameworks for the impact of biofuels (building on those already set out in the UK's Renewable Transport Fuels Obligation, which mandates biofuels uptake) and meeting the challenge of providing credible whole life greenhouse gas assessments. As the Gallagher Review outlines, the current system of targets is not effective in providing assurances about sustainability. Governments therefore need to introduce lifetime GHG emissions rather than volume targets into biofuels inclusion obligations as soon as is practicable.

They can also play a role in providing incentives for future developments either through direct subsidy or in ensuring regulatory and legal frameworks are supportive: for example in waste management where the use of biomass from municipal waste will be an important consideration in influencing future revisions of the UK Waste Strategy.

Should we even try to do this?

Given the change in sentiment toward biofuels, the question does need to be asked as to whether they have any future. We think the answer is yes. We agree with the Gallagher Review that biofuels should be part of a diversified future transport energy mix. This is alongside a (likely significantly larger) increase in other renewable technologies and, especially, policies to reduce demand for transport fuels.

However, biofuels will only be able to take on this role if their sustainability is assured and appropriate technologies are developed and put in place. That means the industry needs to put in considerable pre-emptive effort to develop its strategy for the future, and it needs to do so now.



Merkel Visits Biofuels Plant

Sun Diesel, a diesel-compatible fuel produced through Biomass-to-Liquids (BTL), and other products of Choren Industries GmbH are seen in front of the new Choren Industries GmbH biofuels plant at the opening on April 17, 2008 in Freiberg, Germany. The Choren plant is a breakthrough in biofuels technology, as it produces fuel not from maize, wheat or other resources that humans also consume as food, but from wood chips and other biomass by-products. The plant is to produce 18 million litres of biodiesel carburant annually and a second, much larger plant is in development. Choren has signed a contract with Shell for its entire SunDiesel production.

To find out more

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