

# Biofuels and other energy alternatives

By Andrea Wild, CSIRO

**O**ur need for greener and more secure transport fuels is creating competition with food production, use of agricultural lands and even the manufacturing of soap.

Competition between food and fuel is perhaps the most prominent issue, with the biofuels industry blamed for everything from rising costs of tortillas in Mexico and rapeseed oil in Europe, to a shortage of hops in small-scale breweries in the United States.

## Food versus fuel

Competition between using crops for food and crops for fuel is sometimes direct, for example diverting sugarcane from producing sugar for human consumption to produce ethanol as an additive to petrol. For other crops the effect is less clear. The picture is more complicated when considering diverting agricultural lands and water to produce feedstocks for biofuels.

In Australia, issues related to food versus fuel or land-use versus fuel haven't been relevant to the biofuels industry because, so far, the industry hasn't been competing with human food or animal feed, either directly or indirectly.

"The biofuels industry here is quite small," explains Dr Deborah O'Connell of CSIRO. "It supplies less than 0.5 per cent of our transport fuel and our biodiesel and ethanol are made from wastes and co-products of food production such C-molasses, waste starch from flour milling, and tallow from abattoirs.

"However, if demand for biofuels in Australia were to expand significantly, the waste products currently being used wouldn't meet the needs of the industry.

"Internationally, the food versus fuel issue is complicated. It's difficult to say whether food prices have increased because of biofuels or whether other issues such as drought, climate change and economic factors are to blame.



**Second generation biofuels from non-food biomass such as forest thinnings, will help quell the food versus fuel debate.**

## AT A GLANCE

- The food versus fuel issue is a prominent debate, with biofuels blamed for rising food prices in some cases.
- Second generation biofuels made from woody waste – garden clippings, plantation waste and sawmill waste – show promise as a way forward.
- Biorefineries of the not too distant future could reduce our dependence on oil, turning cheap waste into valuable products like biofuels, paints and plastics.

"Though biofuels may not necessarily be the key factor causing price hikes in food markets around the world, they have added to the competitive pressures for land use," Deborah says.

While difficult to measure, it seems safe to say that the biofuels industry is placing more demand on crops and agricultural lands, with food, fibre, livestock and biofuel producers competing for the same commodity crops in the international market.

Biofuels are creating competition not only for crops with alternative markets such as human food and animal feed, but waste products

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such as tallow, which is used to manufacture soap and detergents. There are also issues surrounding the effects of diverting water and even human labour to producing feedstocks for biofuels.

New technologies on the horizon don't use food crops but the fibrous woody parts of plants, known as lignocellulose. These technologies can create biofuels from feedstocks such as garden waste, forest and sawmill waste, or even plantations dedicated to energy production.

### Greenhouse benefits of biofuels

Potential benefits of a larger biofuels industry in Australia in the future include regional development, reduced air pollution and progress toward achieving fuel security.

Understanding the greenhouse gas implications of biofuels requires a lifecycle analysis of the different feedstocks and products. If crops are grown from scratch for use as biofuels, then even the greenhouse costs of the tractor used in sowing the seeds and the fertiliser used on the young plants needs to be factored in.

"The outcome is completely different for biofuels based on waste cooking oil from restaurants than for biofuels made from crops like corn which require intensive agricultural practices," says Deborah.

"The lignocellulose feedstocks we've been looking at show quite considerable reductions in greenhouse emissions, but it's by no means something that applies across the board for biofuels."

### Second generation biofuels - the way ahead

Biofuels are moving on from first generation technologies, those using sugar or starch to produce ethanol, and waste oil to produce biodiesel. First generation technologies have been a use-

ful first step in a transitioning away from oil, but to go forward relying only on these technologies would require new sources of oil, sugar or starch.

Second generation biofuels use non-food biomass, such as lignocellulose to make biodiesel and ethanol. Food issues don't come into play, except through indirect competition for land, water and so on, unless the lignocellulose is sourced from green waste that could otherwise be disposed of in landfill.

"Second generation biofuels show promise for making a greater contribution to transport fuel use in Australia, but this is critically dependent on sustainable production of biomass at a competitive cost," says Deborah.

"We are seeing if we can grow feedstock for biofuels on less productive land not suitable for producing human food or animal feed. This could augment using wastes such as garden waste, forest thinnings, crop residues and waste paper as a source of lignocellulose."

Second generation technology recently developed by CSIRO and Monash University for producing a stable bio-crude oil from lignocellulose is on the table for turning cheap waste into valuable end products including petrol and diesel replacement fuels and other high value chemicals.

### Australian development of bio-crude

Bio-crude works in much the same way as crude oil, yielding a stable product that can be produced in local areas from green waste and then transported to central refineries for further processing.

"CSIRO is also looking at making other products currently derived from crude oil," says Dr Simon Potter of CSIRO. "These products could range from biofuels or pharmaceuticals, to textiles and functional food additives."

"Products like paint and plastics traditionally form a large part of the output of crude oil refineries. Being able to make these products in biorefineries from oils derived from lignocellulose would help make biofuels themselves more economically viable."

Biorefineries reducing our dependence on oil, creating greener transport fuels and high-value co-products is one view of the future. Its potential depends on the cost and sustainability of feedstock production and developments in technologies for producing and utilising biofuels and these co-products.

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Research is also looking at biofuel from waste paper.

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