

Fuels from waste

An increasing amount of fuel is now being made from waste products. A massive research effort is underway around the world to improve techniques for converting plant wastes into liquid fuels. It makes sense to consider these fuels in the future to help replace petroleum products and reduce greenhouse gas emissions.

Biofuels from cellulose wastes, like straw, grasses and wood have been touted as taking over from the grain ethanol plants of today. Already grain is in short supply around the world and new fuel sources are needed.

Two processes are competing in the race to produce viable fuels. Most of the research has been on the breakdown of the cellulose by enzymes and bacteria to sugars, which are then converted into ethanol. The main problem here has been that it takes around three days to digest products like straw and wood and this makes the process in a factory very expensive.

Recently, some of the focus has shifted to gasification technologies, which transforms biomass into a gas or liquid, which is then transformed to a fuel such as diesel. The Fisher Tropsch process for converting gas into diesel was developed in Germany during the second world war to provide vehicle fuel. Several large plants, notably in South Africa and Qatar, use this process to convert natural gas into diesel.

The drawback with conversion of biomass or gas into diesel is the much larger capital cost of the plants and the use of a significant amount of energy in the conversion process. Despite the costs, a recent study by the Iowa State University says the process is becoming increasingly competitive with ethanol as the price of corn rises and the production of diesel is competitive with ethanol converted from biomass.

The advantage of diesel is that it has a higher energy content and better fuel consumption. Ethanol has only 67% of the energy in petrol and while fuel consumption remains unaffected in a 10% blend with petrol, it gradually increases as the percentage of ethanol in the blend increases.

However, there are other competitive ways of converting waste into fuel and an even bigger question of 'what is waste?'

One of the alternative fuels being produced from waste is biogas. Large biogas plants are being built in Sweden, Germany and Spain to convert urban waste and farm waste, including manure, into gas, which is upgraded to biomethane. One of the largest plants to be built in Spain, will produce gas for the bus fleets of Madrid, at a rate equivalent to the energy content of 2600 litres of petrol an hour.

Biomethane production is not only a more efficient process than conversion to liquid fuel, the use of methane in vehicles results in cleaner exhaust emissions which improves the air quality in cities.

Commercial forestry operations produce a lot of waste timber, at thinning time and during the logging process where less than 50% of the tree is converted into boards or other products. However, some of this waste already goes into wood chips for paper production and a big industry is developing in Europe which turns sawdust and waste wood into wood pellets.

The use of wood pellets as an oil substitute in boilers, both in factories and for home heating is a more efficient process than converting waste wood into liquid fuels. There would have to be a huge premium for diesel over heating oil to compete for the use of timber wastes.

Straw and grass has been suggested to be a good feedstock for biofuel plants, but are they really waste? Crop stubbles maintain soil carbon levels. Any significant use of crop stubble will not only reduce soil carbon, it will impact in other ways by increasing soil erosion and reducing the water quality of runoff. There is potential to rob carbon from Peter to pay Paul here, if we develop biofuels as a way of reducing greenhouse gas emissions, but end up with less carbon stored in the soil.

Growing grass for conversion to biofuel is another idea with growing momentum. Such land use will mostly be in direct competition with beef cattle production. Although the return from biofuel might beat beef economically, if it grows to any extent like the grain ethanol juggernaut in the USA, then there will be a lot less beef and much higher prices.

One of the most likely waste products we have in Australia to convert into biofuel is bagasse – the shredded stems left over from sugar production. The advantage of bagasse is that it is already harvested and transported to a factory. The disadvantage of using it for biofuel is that it is not available for the return of organic matter and nutrients to cane farming land. Some of it is already being burnt for electricity production at sugar mills.

The only 'real' waste biomass we have is urban waste, which is otherwise dumped in landfill. There is enough waste in each of our major cities for a gas or biodiesel plant. A small power station is being built in Darwin to burn urban waste. But in most of our cities it is cheaper to use natural gas as a fuel. Hefty carbon taxes will be needed to make the conversion of waste viable.