Opportunities for biofuel production on Māori land

Donna Giltrap, Anne-Gaëlle Ausseil, Garth Harmsworth, Kevin Tate
Manaaki Whenua, Landcare Research
Private Bag 11052 Palmerston North
Phone: (06) 356-7154
Email: giltrapd@landcareresearch.co.nz Website: www.landcareresearch.co.nz

Manaaki Whenua
Landcare Research

Biofuels

Biofuels are derived from land via recent plant or animal material (biomass). The idea of using biofuels is not recent – biofuel engines have existed since the 19th century – but the availability of cheap fossil fuels has meant biofuel technology has not yet been widely adopted.

There are many different biofuels that can be derived from different types of biomass using different processes. Three common types are:

Ethanol – produced by the fermentation of sugars, so it is easy to produce from biomass with high sugar content. Ethanol can also be produced from other plant matter using chemical treatments to break down the cellulose into sugars. Brazil produces a large amount of ethanol from sugar bagasse. In the United States, ethanol for fuel is produced from corn. Fonterra currently produces 17–21 million litres/yr of ethanol from whey, most of which is exported. (NZMP web site)

Biodiesel – produced by processing oils using a process known as esterification. Some engines run on unprocessed oils, but these tend to have higher viscosity than diesel and can cause problems in unmodified engines. The European Union (in particular Germany and France) is the largest producer of commercial biodiesel, mostly derived from rapeseed oil. New Zealand produces 150 000 tonnes/year of tallow, of which 120 000 tonnes could be converted into biodiesel (Judd 2002).

Biogas – formed in an anaerobic digestor by microbial processes. These processes require the biomass to be kept in airless and warm conditions. Similar processes produce landfill gas. (A generator running on landfill gas near Hamilton is currently running at 750 kW). Biogas is similar in composition to compressed natural gas (CNG).

Biofuels have the potential to benefit the economy and the environment by replacing at least some of the fossil fuels consumed in New Zealand with a renewable energy source. However, it is important to ensure biofuel production is economically and sustainably managed if these benefits are to be realised. There may also be co-benefits from using land to produce biofuels (e.g., erosion control, excess nutrient removal).

Assessing land suitability for growing biofuels

During the oil shocks of the 1970s the potential of energy farming for transport fuels in New Zealand was investigated. The following table shows the energy potential of the crops assessed in typical New Zealand conditions (Harris et al. 1979):

Crop	Net energy yield per ha (GJ/ha)	Equivalent amount of petrol (litres), energy basis
Fodder beet	363	12500
Gorse and macrocarpa	285	9800
Maize ex pasture	276	9500
Maize ex maize	265	9100
Winter green crop	207	7100
Gorse	193	6650
Macrocarpa	189	6510
Lucerne (Hay)	189	6510
Pasture	186	6410
Lupins	159	5480
Sugar beet	153	5270
Peas	82	2830
Straw residue	70	2410

Note the "net energy yield" is the total energy content of the harvested crop minus the energy inputs (assuming standard management practices). However, the energy cost of transporting the harvested crop and processing it into a biofuel has not been included. These crops were selected on the basis of data availability; there may be other suitable crops that have not yet been assessed.

When assessing the feasibility of growing energy crops a number of factors need to be considered:

Crop suitability – will the crop grow well in the soil and climate conditions?

Sustainability – is the land prone to erosion? Will nutrient depletion be a problem? Is it possible to reduce nutrient depletion by returning residues to the land?

Infrastructure – need a market for biofuel produced. Need to be reasonably close to processing plant.

Co-products – is it possible to produce biofuel as a co-product of something else?

Management – will the management systems required be too costly in terms of energy and/or money?

Scale of operation – a small-scale operation usually means lower transport costs but comparatively higher capital costs.

Other potential land uses – is there another potential land use that would give a greater return?

Opportunities for biofuel production on Māori land

Landcare Research maintains comprehensive national and regional databases of the environment – including land resources, flora and fauna, soils and their properties – as a basis for all forms of land assessment and development. Landcare Research also has considerable experience in matching land and soil to crop type and in assessing the potential of land for crop performance, yield, and sustainability.

Potential of Māori land for biofuel production

The following table shows the amount of Māori land in each of the broad "Land Use Capability" (LUC) classes (Harmsworth 2003). Note that in this table "Māori land" refers to all Māori freehold land defined by Te Ture Whenua Māori Act 1993

Māori Land-Use Capability – New Zealand – 2003

Land-Use Capability Class	% of Total NZ Land	% of Māori Land	2002 Māori Land area (ha)	Description of Land-Use Capability
1	0.7%	0.3%	2771	Most versatile multiple-use land – virtually no limitations to arable use
2	4.6%	2.3%	18 419	Good land with slight limitations to arable use
3	9.2%	4.9%	40 339	Moderate limitations to arable use restricting crops able to be grown
4	10.5%	9.9%	81 147	Severe limitations to arable use. More suitable to pastoral and forestry
5	0.8%	0.4%	3 386	Unsuitable for cropping – pastoral or forestry
6	28.1%	33.7%	275 484	Non-arable land. Moderate limitations and hazards when under a perennial vegetation cover
7	21.4%	31.7%	259 370	With few exceptions can only support extensive grazing or erosion-control forestry
8	21.8%	15.5%	127 023	Very severe limitations or hazards for any agricultural use
Other	2.9%	1.2%	9 927	Non-arable land. Moderate limitations and hazards when under a perennial vegetation cover
TOTAL	100.0%	100.0%	817 866	

From these broad categories there are about 21 190 ha of Māori land highly suitable for cropping, an additional 121 486 ha that could sustain some cropping but with limitations, and 278 870 ha that could be used for perennial crops or forestry. More detailed analysis would be required to assess the suitability for specific crops.

Summary

- Technically feasible, but investment in infrastructure required, e.g., processing plants.
- 142 676 ha of Māori land has an LUC suitable for cropping (of this 21 190 ha is highly versatile land, while 121 486 ha has moderate to severe limitations).
- 278 870 ha of Māori land has an LUC that could support pasture or forestry.
- Need to match crops to climate and land properties.
- Need to consider the whole farm system for long-term sustainability e.g. managing nitrogen leakage, erosion control).
- Economic feasibility needs to be assessed.

References

Harmsworth G. (2003) "Māori perspectives on Kyoto Policy: Interim results." Reducing Greenhouse Gas Emissions from the Terrestrial Biosphere (C09X0212). Landcare Research Report LC0203/084. Discussion paper for policy agencies (Climate Change Office, MfE, MAF, TPK) *Updated November GIS tables and statistics.* 30 p. http://www.landcareresearch.co.nz/research/greenhouse/c_co2.asp

Harris G.S., Leamy M.L., Fraser T., Dent J.B., Brown W.A.N., Earl W.B., Fookes T.W., Gilbert J. (1979) "The potential of energy farming for transport fuels in New Zealand" New Zealand Energy Research and Development Committee, Report No. 6. University of Auckland

Judd B.T. (2002) "Biodiesel from tallow" Report prepared for the Energy Efficiency and Conservation Authority, Wellington, New Zealand.

NZMP website (http://www.nzmp.com/cda/frontpage/0,,c334829_g500040,00.html)