A Viable Biofuels Industry in Australia?

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Paper prepared for presentation at the "Biofuels, Energy and Agriculture: Powering Towards or Away From Food Security?" conference conducted by the Crawford Fund for International Agricultural Research, Parliament House, Canberra, Australia, August 15, 2007

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Transport fuels in Australia are overwhelmingly based on petroleum products; petrol, diesel and LPG are the primary fuels. The concept of 'peak oil' is now within the arena of public debate with the realisation that this will result in rapidly increasing oil, and therefore transport fuel, prices. When this is coupled with instability in areas of the world that contain most relatively easily extractable oil reserves, and hence supply security issues, at least two drivers for the exploration of alternative transport fuel supplies are clear.

One alternative to supply at least the part of Australia's future transport fuels is the range of biofuels that can be made from agricultural products such as sugar, wheat and oilseeds. There are, however, a myriad of issues associated with that simple statement. These include:

- how much of Australia's fuel needs can be met from biofuels?
- the potential competition between food and 'energy' crops
- do we have the water/soil quality to make the impact required?
- how do biofuels compare with alternatives such as gas and coal conversion to liquids?
- would a carbon price enhance the uptake of biofuels?
- is there a role for genetic modification of energy crops?
- what is the impact of 'second generation' conversion technology?
- what policy regime should be adopted to optimise biofuels viability?

From the above incomplete random list of issues, it can be seen that they are a complex mix of economics, technology and policy.

This paper examines the current state of the biofuels industry in Australia and explores possible futures for the biofuels industry in the light of the issues above.

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Introduction

As with most things connected with Australia's energy situation, the future role that biofuels will play in Australia's energy mix is complex and unclear. Australia has a fledging biofuels industry with reasonable growth prospects under a supportive, but time-limited, fuels production/capital grant scheme. The federal government has set a biofuels target of 350 ML by 2010 and current indications are that this target will be exceeded[1]. This equates to less than 1% of Australia's total transport fuel demand and at this level it will remain a niche industry with limited prospects. There are several drivers, however, that could assist the accelerated growth of the industry to contribute more to Australia's future fuel mix.

Biofuel drivers

Drivers include:

- Potential reduction in greenhouse gas (GHG) emissions from the transport sector — reductions depend on the feedstock, the product being produced and the technology employed. These aspects are covered in detail in a recent Rural Industries Research and Development

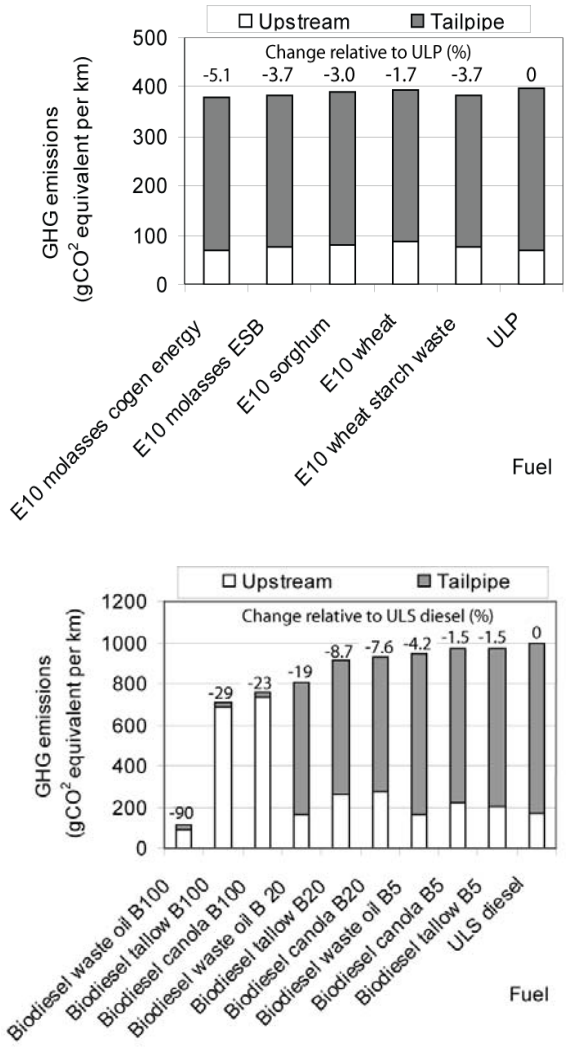


Figure 1. GHG emissions

Corporation (RIRDC) report[2]. Figure 1 shows a summary of potential greenhouse gas emission reductions from the use of E10 (10% blend of ethanol in petrol) and biodiesel in various blends with diesel from petroleum. The plots show that when used in an E10 blend, GHG emissions are lower than from unleaded petrol by 1.7–5.1% depending on the feedstock. Obviously, higher ethanol blends would further reduce GHG emissions, but these would require modifications to engines and/or the introduction of multi-fuel vehicles into Australia. The use of 100% biodiesel from waste oil has the potential to reduce GHG emissions by as much as 90% over petroleum diesel. The reductions are less at lower ratios of biodiesel blends as shown.

- Increased transport fuel security — there is constant upward pressure on the price of oil as resources of known 'sweeter' oil grades decline and processing costs increase. Australia has already reached a production peak and the Australian Bureau of Agricultural and Resource Economics (ABARE) predicts that we will be less than 50% self-sufficient by 2030[3]. With the emergence of developing countries, oil demand will also continue to increase rapidly and it is not too difficult to envisage heightened competition for a resource at the very time that that resource is reaching a world production peak. Couple that with the world's main oil supply coming from politically unstable parts of the world and fuel security, and the development of fuel alternatives, takes on significant risk management aspects.
- Fuel cost management — the growth of a viable biofuels industry is critically dependent on the price of oil. There are indications that biofuels production is economically feasible at oil prices above US$40 per barrel (Fig. 2), but this very much depends on specific cases: that is the feedstock, transportation costs, market demand, conversion technology used etc. These costs are discussed in some detail in the RIRDC report[2] for first-generation technology producing ethanol and biodiesel.
- Social benefits — these include potential air quality health benefits from the substitution of biofuels for petroleum products, potential land and water benefits from, for example, the growing of oil mallee in low-rainfall areas and specific benefits to regional Australia such as enhanced agricultural activities.

Issues to be addressed

While there is a range positive drivers for an expanded Australian biofuels industry, there is also a host of issues, some very specific to this country, that need detailed examination if the industry is to be more than a minor player in Australia's fuels future. They include:

- scale of a future industry
- availability of suitable feedstocks
- competition with food crops
- impacts on other industries — e.g. livestock
- infrastructure needs

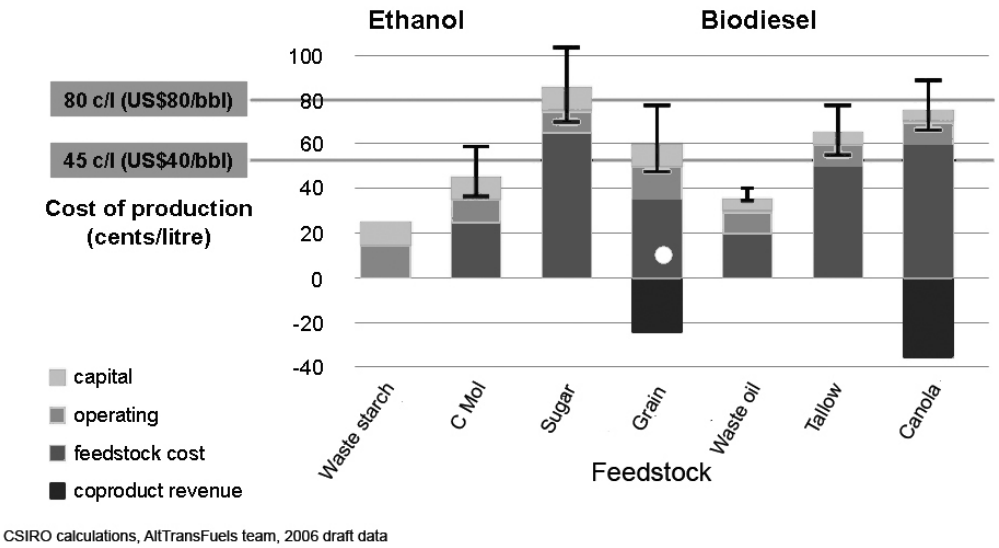


Figure 2. Estimates of current cost competitiveness

- fuels policy
- effect of a carbon 'price'
- other synthetic fuel alternatives
- consumer preferences
- vehicle technologies
- biomass conversion technologies
- appropriate transition pathways

This is a rich mix that stresses the complexity of the development of a biofuels industry at a reasonable scale. Each issue needs considerable systematic analysis.

Taking for example the issue of biofuels feedstock availability, Figure 3 is a summary of estimates of upper limits of production of first- and second-generation technology biofuels (adapted from the RIRDC report). The plots show firstly that there is a high degree of uncertainty in the estimates and secondly, the production potential increases markedly with the introduction of second-generation technology. First-generation technology refers to the production of biofuels from sugar/starch crops and oil plants, and second-generation technology refers to the use of whole plants through lignocellulosic processing and/or gasification and synthesis gas conversion to fuels and products. Figure 4 summarises some first- and second-generation technology pathways and products. Interest is also increasing in the growth and conversion of microalgae to fuels as a second-generation technology. One variation, shown in Figure 5, uses carbon dioxide captured from power plant flue gases to enhance the growth of algae for conversion to suitable fuels and products.

Industry scale

At the current biofuels production scale, and up to the 350 ML target by 2010, the above issues will have little impact on either future biofuels implications or agribusiness in Australia. There is, however, considerable potential for production well in excess of the 2010 target and it is interesting to look at some of the possible consequences at various substitution levels[4].

- At the margins — biofuels stabilise at 2–5% of Australia's demand. The production could be limited by lack of cost-competitiveness, feedstock supplies and consumer resistance associated with perceptions that elevated levels of biofuels will harm engines. There are few R&D implications at this level.
- Biofuels make up 10–20% of Australia's demand. Oil prices would need to remain consistently above US$50–60 per barrel. There are only minor implications for vehicle technology. The level could be achieved with first-generation feedstocks (grain, sugar, oilseeds). There would be some increases in feedstock production and redirection from domestic and export markets. Broadacre agriculture would be significantly different (20–30% of crop output directed to biofuels). Additional R&D needs would include a better life cycle understanding of GHG implications, farming systems 're-optimised' for biofuels products, improved biofuel conversion technology efficiency, vehicle technology adaptations and better understanding of sustainability implications.

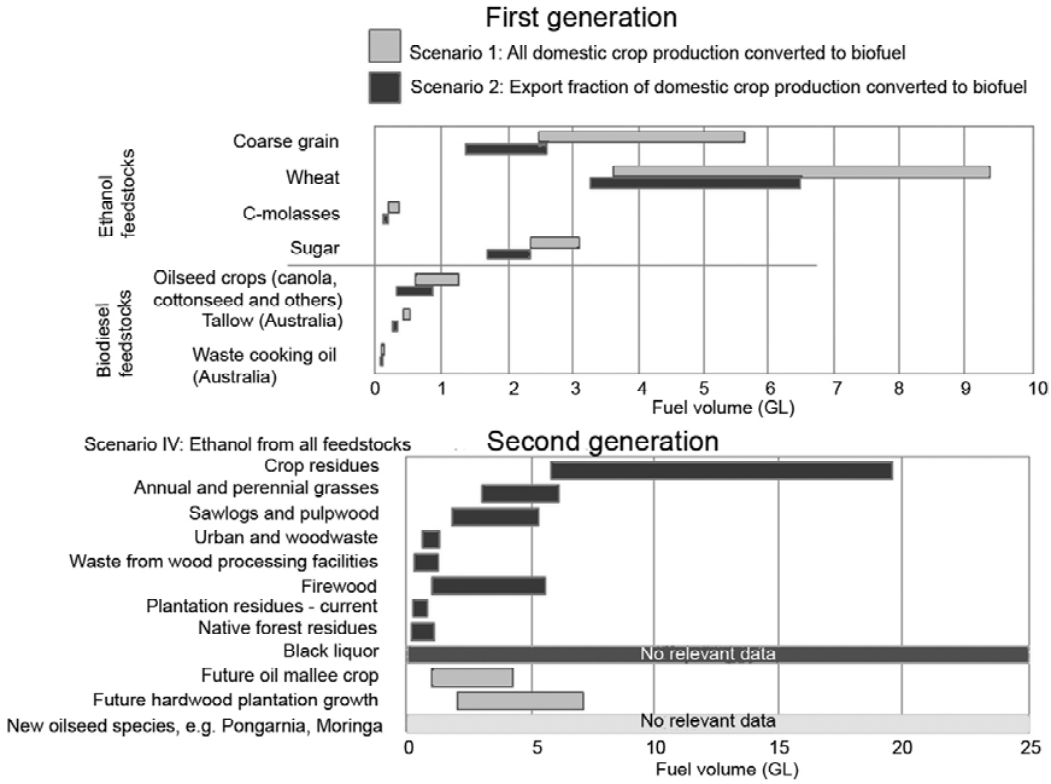
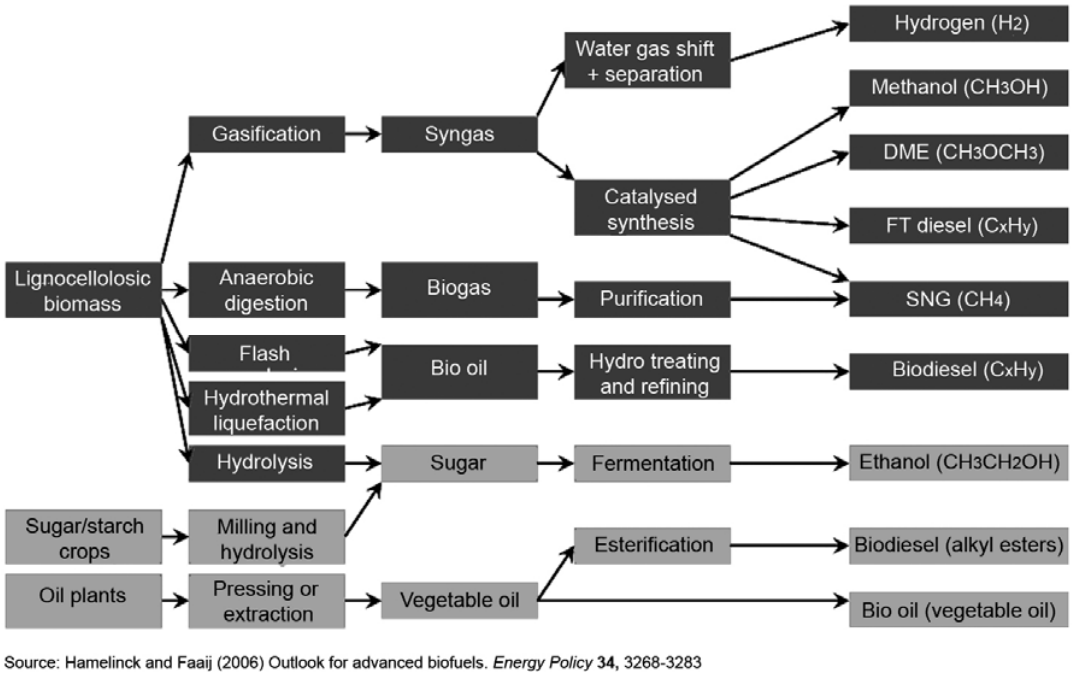


Figure 3. Availability of biomass resources



Source: Hamelinck and Faaij (2006) Outlook for advanced biofuels. *Energy Policy* **34,** 3268-3283

Figure 4. First-and second-generation biofuels technologies

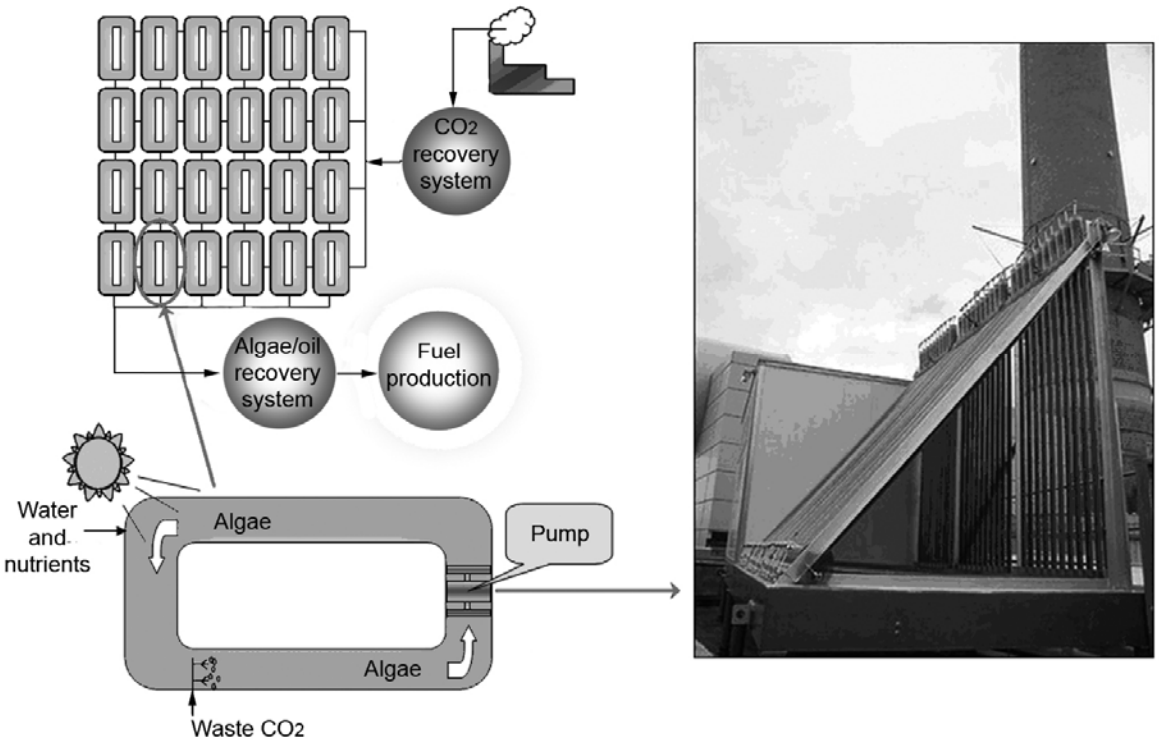


Figure 5. Algae – another second generation biofuel possibility? [4]

- Biofuels becoming a major transport fuel source — greater than 20% of fuels substitution. At these and increased levels, biofuels production would have to be based on lignocellulose (use of the entire plant and tree biomass) production and transformation. There would need to be a radical change in rural enterprises and regional economies. Multi-fuel vehicles would be required to use the biofuels. The R&D needs would be considerable as Australia would need transformational change in agriculture (and forest industries and waste management). Sustainability implications would be paramount in terms of water, plant nutrients and GHG balances. There could be major negatives if additional land needed to be cleared. There could also be landscape benefits, such as salinity control in some regions. The major R&D challenge is to develop technological innovation in lignocelluose transformation suited to Australian feedstocks.

To put this in context, even at high production rates, biofuels will only be part of Australia's future fuels mix and the drivers for alternative fuels apply equally well to synthetic fuels from Australia's abundant gas and coal resources. These sources and processes will need to be appropriately integrated into the nation's fuel production and delivery systems. In many cases bio-, synthetic and petroleum-based fuels will be blended in appropriate mixes. It is highly probable that biomass and fossil fuels will be combined in hybrid gasification processes for Fisher-Tropsch conversion to liquids. All these are exciting prospects and we have only begun to explore this very different fuels future, prompted by the implications of the increasing price of oil.

Charting a way forward

Australia's future fuels supply is now receiving an enhanced degree of attention through the government biofuels target[1], the biofuels taskforce[6] and the major expansion of alternative transport fuels activities in the CSIRO Energy Transformed Flagship Program (an additional $59.6M over 4 years).

CSIRO has recently completed a report on the issues and prospects for biofuels in Australia (RIRDC[2]) and is currently running a series of biofuels issues workshops in partnership with ATSE

to garner expert comment and information from Australian industry and academic experts in the field.

CSIRO is also in the process of setting up a Future Fuels Forum involving industry, governments, peak bodies, and environmental and public interest groups as input to the development of a 'roadmap' for the development of alternative transport fuels in Australia. We believe that a fuels roadmap resulting from wide consultation will assist to focus disparate frameworks and goals, value trains, industry efforts and public benefits, and inform government policy to chart the way forward[7].

Conclusions

Biofuels are likely to play a significant role in the future of Australian agriculture and future fuels mix, but considerable uncertainties and challenges need to be resolved. These include:

- oil prices, fossil fuel alternatives and commitment to action on greenhouse gas emissions and climate change
- greenhouse gas emission reductions need to be unambiguously favourable
- technology development and adoption — the role of first- and second-generation technologies and their impact on agribusiness
- food–feed–fuel-fibre market interactions at national and global scales
- land and water — likely to be increasingly contested for food, energy, fibre and conservation
- fit with agricultural enterprises, environments, and regional economies and communities.

In the end, it is all about sustainability. The transition to a significant biofuels contribution will need strategic R&D to assist investments informed by integrated biophysical, economic, technical and social analysis.

Acknowledgements

Thanks to the Crawford Fund for this biofuels symposium, to RIRDC for information from *Biofuels in Australia: Issues and Prospects 2007*, and to the CSIRO biofuels team for supplying information: David Lamb, Brian Keating, David Batten, Tom Beer, Tony Miller, Deb O'Connell, Michael O'Connor, Tim Grant and Mick Poole.

References

1. Howard, J. (2006) *Biofuels Action Plan*. www.pm.gov.au/media/Release/2005/media_release1734.cfm (accessed august 2007).

2. O'Connell, D. et al. (2007) *Biofuels in Australia: An Overview of Issues and Prospects.* Rural Industries Research and Development Corporation Publication No. 07/070. RIRDC, Canberra, 19 pp. Available at: http://www.rirdc.gov.au/reports/EFM/07-071sum.html.

3. ABARE (Australian Bureau of Agricultural and Resource Economics) (2006) *Energy in Australia 2006*. ABARE, Canberra, ISSN 1833-038X

4. Keating, B. (2006) Biofuels from Australian agriculture. In: *Biofuels: From Paddock to Pump*. Australian Institute of Agricultural Science and Technology Symposium, 19 October 2006, Canberra. 50 pp. Available at: http://www.aiast.com.au/pdf/Meetings/Canberra%202006/Brian%20Keating%20presentation.pdf

5. The Energy Blog (2005) *Biodiesel from Algae is Here*. Available at: http://thefraserdomain.typepad.com/energy/2005/06/university_of_n.html

6. Biofuels Taskforce (2005) *Report of the Biofuels Taskforce to the Prime Minister*. August 2005. Department of the Prime Minister and Cabinet, Canberra, 240 pp. ISBN 0646-45241-X

7. CSIRO (2007) *Future Fuels Forum*. www.csiro.au/news/futurefuelsforum.html