



BIOFUELS: SUITABILITY AND SUSTAINABILITY

A research paper examining recent developments in biofuel technology, production and policies in Australia and overseas

August 2008

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Executive Summary

At a time of significant concern around the world about climate change and oil supplies, biofuels hold promise as clean burning, renewable sources of energy. The prospect of lessening their reliance on oil imports and reducing vehicle emissions, while assisting rural industries has lead governments, in particular those of the United States and European Union, to set required minimum targets on the amount of biofuels used for transport.

The RACQ is concerned about the effectiveness of mandates as means of assisting industry, problems with the use of biofuels in the existing infrastructure and vehicle fleet, and the extent of environmental gains offered by current biofuels when considered over the whole lifecycle of the fuel.

The New South Wales Government imposed a requirement that from 1 October 2007 ethanol comprise at least 2% of all petrol sold in that state. The Queensland and Victorian governments have proposed their own mandates on the grounds of regional development, increased fuel security and, at least partially, environmental protection. The RACQ has a long-standing opposition to the proposed Queensland ethanol mandate. In February 2008 a Victorian Parliamentary Inquiry into proposed biofuel mandates concluded the risks of the mandates outweighed any potential benefits.

The environmental advantages of biofuels depend heavily on their method of production. For example, conversion of corn or grains to ethanol can consume more energy and release more emissions than saved through growing the feedstock and using the fuels. In addition, if forests are cleared to grow feedstock, the resultant release of carbon to the atmosphere is many times more than the carbon saved by substituting the biofuel for petroleum fuels.

New technologies are being researched to produce cellulosic ethanol from the stems and stalks of crops rather than just the food component, and to use more hardy plants such as grasses, wood chips or even waste. These 'second generation' processes may hold the key to the success of ethanol, but commercially viable production of cellulosic ethanol is still up to ten years from realisation.

The issues of poor environmental performance of biofuels are being overtaken by increasing alarm at the impact of the biofuel industry on current global food shortages. While the extent of this impact is argued, many scientists and leaders have expressed opinions that the push for biofuels is coming at the expense of food supplies in developing countries. The United Nations is leading calls for government policies on the use of biofuels to be reconsidered in the light of the unintended consequences of these policies to date.

Background

The Royal Automobile Club of Queensland (RACQ) has a long-standing interest in the use of biofuels in motor vehicles. This interest is founded in the policies set out in the RACQ Advocacy Charter. The policy on provision of fuels and other automotive products is:

The automotive and petroleum industries, actively encouraged and supported by government, should undertake research and development and other initiatives to bring to the market new or improved fuels and other related products which will enhance the automotive, environmental and economic performance of road transport.¹

The Advocacy Charter also identifies areas of environmental concern pertinent to motoring: technology and standards relating to pollution and greenhouse gas emissions; and scarcity of resources including fossil fuels.

Increasing community and government concern about environmental issues and the growing acceptance of the finite nature of the world's oil resources has driven the production and uptake of biofuels around the world. For example, the Queensland Government proposes by 2010 to require that ethanol makes up at least 5% of the total volume of petrol sold in Queensland. Similar biofuels mandates and targets have been imposed or are under consideration in other Australian states and overseas.

The RACQ has maintained a consistent position on biofuels over some years, aimed at protecting the interests of motorists. This position includes:

- ensuring motorists' freedom of choice and opposing government mandates
- requiring clear labelling of biofuel outlets
- supporting research into emerging technologies that would provide clear environmental benefits
- preventing additional cost to motorists.

This paper examines recent developments in biofuel technology, production and policies in Australia and overseas, and will inform any review of the RACQ's position on biofuels. Statements based on this research will be released to advise members, the wider community and governments of the club's position on issues such as suitability of biofuels for members' use, the environmental impacts of using biofuels and mandates on biofuel sales.

¹ Royal Automobile Club of Queensland *RACQ Advocacy Charter* October 2006

Automotive Performance

Biofuels cannot automatically replace petroleum products as transport fuels. There are significant technical considerations that impact on the storage, transport and use in vehicles of biofuels.

Suitability of vehicles for ethanol blend petrol

In May 2005 the then Prime Minister appointed a task force that produced an important Australian study of the health, environmental and automotive impacts of biofuel. The task force assessed the cost and benefits of biofuel production in Australia and examined:

- the findings of the December 2003 desktop study by the Commonwealth Scientific and Industrial Research Organisation (CSIRO), the Australian Bureau of Agricultural and Resource Economics (ABARE) and the Bureau of Transport and Regional Economics (BTRE) into the appropriateness of a 350 million litre (ML) biofuels target
- the findings of the Department of the Environment and Heritage study into the impacts of 10% ethanol (E10) and 20% ethanol (E20) on engine operation
- other international and Australian scientific research on the health and environmental impacts of supplementing fossil fuels with oxygenates such as ethanol and other biofuel blends
- the economic and scientific bases upon which decisions have been made to support ethanol and other biofuel production in North America, Europe and other countries².

Only liquid biofuels used for transport and able to be produced by technology existing at the time were considered by the taskforce. This limited its consideration to ethanol, an alcohol made from the fermentation of grain, corn or sugar, and biodiesel made from vegetable oils, used cooking oils or animal fats. These fuels are often blended with fossil fuels for use in vehicles.

The taskforce noted vehicle problems associated with the distribution of 20-30% ethanol blend petrol around Sydney in 2002-03. Reports of damage to vehicles due to the use of this petrol and subsequent public concerns of consumer groups including the RACQ and the Australian Automobile Association led to a significant loss of public confidence in ethanol blend petrol.

The Australian Government responded by requiring labelling of petrol containing more than 1% ethanol and introducing a limit of 10% ethanol in petrol. However by 2005, lack of public confidence was still a major barrier to the use of ethanol. The taskforce reported biodiesel did not suffer the same

² Australian Government *Report of the Biofuels Taskforce to the Prime Minister* August 2005

lack of consumer confidence, but noted such confidence is fragile and warned biofuel producers to take care to meet fuel quality standards and properly advise consumers about fuel blends.

Based on the studies available at the time, the taskforce concluded that almost all vehicles manufactured after 1986 could operate satisfactorily on E10. Vehicles with carburettor or mechanical fuel injection are not generally suitable for use of E10, although manufacturers are the best source of advice on the use of fuels in their vehicles. The NSW Department of Environment and Conservation advised that pre-1986 vehicles made up only about 4% of the Sydney fleet at that time.

A subsequent study for the Australian Government by Orbital Australia Pty Ltd found that as much as 40% of vehicles on Australian roads in 2006 were not suitable for use of E10. In addition, Orbital Australia reported that effectively all carburettor vehicles are not compatible with 5% ethanol petrol (E5). This includes:

- the majority of pre-1986 vehicles
- some medium sized cars built through to the late 1980's
- some small cars built up to 1994
- some 4WDs and light commercial vehicles built through to 2003.

Orbital concluded that, contrary to the recommendation of the Prime Minister's Taskforce, E5 should not be sold unlabeled in Australia³.

The Australian Government Rural Industries Research and Development Corporation and the National Farmers' Federation commissioned a further report on biofuels in 2007. The CSIRO was requested to provide information to enable an assessment of the risk and opportunities for large-scale biofuel production in Australia⁴. The report noted that, while manufacturers generally do not warrant damage to motors caused by the use of more than 10% ethanol petrol, some manufacturers also refuse to warrant damage from petrol containing less than 10% ethanol.

Concerns about the compatibility of ethanol blend petrol with current vehicles and the price impacts of mandates were also raised by the Federation Internationale de l'Automobile (FIA) in its 2006 submission on the European Union Biofuels Directive. The FIA stated that it is not guaranteed that E5 will not damage cars. In addition, overcoming the problems of water affinity and vapour pressure abnormalities lead to a complex production process and higher costs to consumers. Therefore the FIA considers the addition of ethanol is only acceptable at blends of less than 5%⁵.

³ Orbital Australia Pty Ltd *Assessment of the Operation of Vehicles in the Australian Fleet on Ethanol Blend Fuels* February 2007

⁴ CSIRO *Biofuels in Australia – issues and prospects* May 2007

⁵ The Eurocouncil of the Federation Internationale de l'Automobile *Public consultation of the European Commissions on the review of the EU biofuels directive, April-July 2006* July 2006

Infrastructure issues for ethanol

Issues of the damage that ethanol could cause fuel systems also apply to the storage and supply of E10. These issues were raised by the RACQ in March 2008 in a letter to the Queensland Premier opposing the proposed mandate on ethanol fuel sales in Queensland⁶. The RACQ noted that ethanol has a scouring effect on old storage tanks that results in contaminants in fuel and leakage from tanks that are adequate for unleaded petrol. Consequently, some petrol retailers would have to replace old storage tanks to store E10. The RACQ considers it likely the cost of these new tanks and other upgrades would be passed on to consumers. Alternatively, some retailers may be forced to close, leading to reduced choice for consumers and, ultimately, higher prices.

The RACQ also raised the concern that requiring the sale of E10 would lead to retailers who have a limited availability of storage tanks replacing standard 91 RON or 95 RON unleaded petrol with E10. There is evidence of this having occurred in South-East Queensland already. This replacement would force drivers of vehicles that cannot use E10 to purchase premium unleaded petrol, at usually 8 cents or more per litre higher price, and possibly reduce the choice of other alternative fuels available.

In response to the RACQ's letter to the Premier, the Minister for Tourism, Regional Development and Industry advised that the Queensland Government has provided \$4.8 million to assist fuel wholesalers and retailers to convert their infrastructure to manage ethanol blended fuels⁷. The Minister noted that the number of service stations selling E10 has increased from 40 in 2005 to over 330 in May 2008. With regard to the 40% of vehicles that are not suited to E10, the Minister advised that implementing the mandate on the basis of total volume of fuel sold provides for the continued supply of non-ethanol fuel options.

At around the same time as the RACQ was raising issues of fuel supplies with the Queensland Government, similar concerns about the continued supply of standard unleaded petrol led to the German Government abandoning plans to require all petrol sold in that country to contain 10% ethanol. The German Environment Minister said that about three million cars were not suitable for E10, and the planned increase in ethanol content (up from 5%) was scrapped to avoid forcing millions of drivers to pay additional costs for premium unleaded petrol⁸. The German Automobile Association (ADAC) previously warned of possible damage to vehicles and increased motoring costs resulting from the proposed requirement for E10⁹.

⁶ Gillespie, Ian letter to Hon Anna Bligh MP Premier of Queensland 27 March 2008

⁷ Boyle, Desley letter to Ian Gillespie, CEO RACQ 28 May 2008

⁸ just-auto.com *Germany: Government scraps compulsory biofuel blending plans* 4 April 2008

⁹ ADAC (German Automobile Association), *Questions and Answers about E10* (translation) <http://www.adac.de> accessed 14 April 2008

Increased fuel consumption for ethanol blend fuel

In vehicles that do use E10, the lower energy content of ethanol compared to petrol results in higher fuel consumption. The Prime Minister's Taskforce reported an increase of up to about 3% in consumption, and this figure was confirmed by the RACQ after extensive testing¹⁰. The taskforce noted this increase in consumption should transfer to an E10 price reduction at the pump of several cents per litre¹¹. For an unleaded petrol price of \$1.30 cents per litre (cpl), the fuel consumption penalty would require a saving of at least 4 cpl.

For higher percentage ethanol blends, the increase in fuel consumption rises significantly. In the United States, E85 is commonly available for use in flex fuel cars, and sells for a price 18% lower than gasoline. However, the American Automobile Association calculates that the effective cost per mile of E85 is 8% higher than that for gasoline when the 32% increase in fuel consumption for E85 is taken into account¹². It is reported that this loss of efficiency is due to the flex-fuel engines being tuned to run on petrol rather than ethanol. Various researchers state that the fuel consumption of E85 can be improved dramatically through the use of high-flow fuel injectors and much higher compression ratios than is usual for petrol engines¹³.

Biodiesel use and infrastructure issues

Issues of compatibility with current vehicles and fuel storage and supply systems also limit the use of biodiesel. The Prime Minister's Taskforce recommended that blends of up to 5% biodiesel (B5) should not require labelling, based on the advice of engine manufacturers that higher biodiesel content raises issues with engine performance, efficiency, emissions and warranties¹⁴. However the taskforce described trials of 20% blend fuel (B20) that indicated no adverse effects from its use and indicated B5 and B20 provide the best potential for the acceptance of biofuel in Australia.

The CSIRO report on biofuels noted that in Australia, manufacturers claimed that use of fuel blends with biodiesel content higher than B5 raise significant issues involving engine performance, efficiency, emissions and warranties. Some manufacturers also considered any use of biofuels to void the warranty. This is inconsistent with the labelling requirements and the position of manufacturers elsewhere in the world, who accept blends up to B20¹⁵. The CSIRO also noted reports that blends up to 26% biodiesel would meet the petroleum standard. The reasons for these inconsistencies were not clear to the CSIRO, who called for more research on these issues.

¹⁰ RACQ Vehicle Technologies Department personal communication May 2008

¹¹ RACQ *RACQ Position on Ethanol-Blended Petrol Reaffirmed Following Biofuels Taskforce Report* October 2005

¹² *Biofuels Digest Improve e85 mileage 20 percent with high-flow injectors, says publisher* 11 June 2008 <http://biofuelsdigest.com/blog2/2008/06/11/improve-e85-mileage-20-percent-with-high-flow-injectors-says-publisher/> accessed 12 June 2008

¹³ *ibid.*

¹⁴ Australian Government *Report of the Biofuels Taskforce to the Prime Minister* op. cit.

¹⁵ CSIRO *Biofuels in Australia – issues and prospects* op. cit.

The lack of acceptance of biodiesel by consumers is still an issue for the industry. A forum in Brisbane in 2008 provided the biodiesel industry the opportunity to promote their product to representatives of consumers, governments and environmental groups. Presentations by biodiesel producers and consultants described trials of B20 in buses and trials by Brisbane City, Logan City and Noosa Shire Councils that indicated no loss of performance, increased fuel consumption or maintenance issues. The use of a 10 micron filter in bowsers was recommended to ensure that any containments introduced into the fuel by the scouring action of biodiesel on tanks do not damage fuel systems¹⁶.

A significant issue for the biofuel industry is the current Australian tax regime that effectively provides a barrier for fuel blends of greater than 20% biodiesel. The biofuel industry seeks liberalisation of the Australian Biodiesel Standard to permit these blends to meet the standard and therefore qualify for the fuel excise subsidy and energy grants. Another issue is that higher concentration blends of Australian biodiesel, made from tallow, are prone to clouding, waxing and solidification at cold temperatures¹⁷.

Consumer confidence issues

Concerns and confusion about the suitability of biofuel blend fuels continues to limit the uptake of biofuels. In a 2008 survey of driving behaviour, 41% of motorists surveyed reported being concerned whether biofuel blends are suitable for their vehicles¹⁸. In the same survey, 42% of drivers reported changing their driving behaviour to save fuel. Even with biofuels perceived to be cheaper and more environmentally friendly, and fuel prices above \$1.50 per litre, the biofuel option still has a number of obstacles to overcome to sustain consumer acceptance.

Environmental Performance

In any assessment of the environmental performance of fuels, it is crucial that all impacts over the entire fuel 'life cycle' including production, storage and use be considered. This 'well to wheel' analysis is especially important in the case of biofuels, where the source of biological material (feedstock) from which the fuel is produced and the method of production make significant differences to the overall environmental performance of the fuel.

Vehicle emissions for ethanol blend fuel

The 2005 Prime Minister's Taskforce reported the main environmental advantage of E10 could be significantly reduced particulate matter tail-pipe emissions over unleaded petrol, but more work was needed to quantify the

¹⁶ RACQ Vehicle Technologies Department op.cit.

¹⁷ CSIRO *Biofuels in Australia – issues and prospects* op. cit.

¹⁸ AAP 'Drivers change habits to save fuel' *Business Spectator* 6 June 2008

<http://www.businessspectator.com.au/bs.nsf/Article/Drivers-change-to-save-fuel-survey-FC44N?OpenDocument&src=ea> accessed 6 June 2008

effect¹⁹. Levels of carbon monoxide are reduced over the life cycle of ethanol fuel. The taskforce noted any benefits in particulate matter emissions would need to be weighed against the increased evaporative emissions of smog-forming organic compounds from ethanol blend petrol.

However a 2008 Victorian Government inquiry into mandatory ethanol and biofuel targets reported significantly increased particulate matter emissions for ethanol when measured over the entire life cycle²⁰. Both the Victorian inquiry and the taskforce, along with the 2007 CSIRO report, noted reduced carbon monoxide emissions for E10 with increased smog-forming compounds.

Reports of US studies provide inconsistent evaluations of the potential for ethanol to add to air pollution. A Stanford University environmental engineer modelled the environmental effects of the US vehicle fleet in 2020 using petrol against the use of E85²¹. While levels of carcinogens benzene and butadiene decreased from E85, those of formaldehyde and acetaldehyde rose. More significantly, using E85 added 22% more hydrocarbons to the atmosphere, which would increase the level of ozone and cause, at least theoretically, about 200 extra deaths per year. However measurements by other researchers of tailpipe emissions of nitrous oxides and hydrocarbons from vehicles using E85 suggested that E85 produced fewer ozone-producing compounds than petrol.

Assessments of the reductions in greenhouse gas (GHG) emissions available through the use of ethanol blend fuel vary substantially depending on the feedstock and methods used to produce the ethanol. Australian studies reported ranges of GHG reductions for E10 compared with unleaded petrol of 0.7% (for wheat feedstock)²² to 5.1% (molasses feedstock with cogeneration of electricity)²³. The use of higher concentration ethanol blends such as E85 could provide GHG reductions of up to 25%, but would require special engines and facilities for storing and supplying the petrol²⁴. This fuel is becoming more widely available in the US and Canada, where General Motors is extensively researching and promoting the use of E85.

Commercial supply of E85 in Australia commenced in Brisbane in April 2008, with other cities to follow through the year²⁵. United Petroleum worked in conjunction with Saab to provide E85 sales coincidentally with the Swedish vehicle manufacturer's release of the first vehicles in Australia capable of using high percentage ethanol blend fuel. These 'flex-fuel' vehicles can run on E85, unleaded petrol or any blend of the two, and are promoted as

¹⁹ Australian Government *Report of the Biofuels Taskforce to the Prime Minister* op. cit.

²⁰ Parliament of Victoria *Inquiry Into Mandatory Ethanol and Biofuels Targets in Victoria* February 2008

²¹ Biello, David 'Want to Reduce Air Pollution? Don't Rely on Ethanol Necessarily' *Scientific American* 18 April 2007 <http://www.sciam.com/article.cfm?od=reduce-air-pollution-do-not-rely-on-ethanol.html> accessed 2 May 2008

²² Australian Government *Report of the Biofuels Taskforce to the Prime Minister* op. cit.

²³ CSIRO *Biofuels in Australia – issues and prospects* op. cit.

²⁴ Australian Government *Report of the Biofuels Taskforce to the Prime Minister* op. cit.

²⁵ Biofuels Australasia 'United front delivers E85 for motoring first in Brisbane' *Biofuels Australasia* March/April 2008 p12

significantly reducing source-to-wheel emissions of carbon dioxide. However, this reduction comes at the cost of a 35% increase in fuel consumption²⁶. It is not clear from the available information that the quoted reductions in carbon dioxide for flex-fuel vehicles take into account this increased fuel consumption.

Vehicle emissions for biodiesel

The environmental performance of biodiesel is a little clearer than that of ethanol. Use of low concentration blends of biodiesel such as B5 increase PM emissions compared to petroleum diesel, but PM emissions for B100 are significantly better²⁷, as are emissions of other pollutants except nitrous oxides²⁸. Reductions in GHG emissions depend strongly on the feedstock used: B5 provides reductions of 1.5% (for canola and tallow) and 5% (waste oil), while the reductions for B100 are 15% (canola), 29% (tallow) and 90% (waste oil)²⁹.

Second generation ethanol production

Life cycle reductions in GHG emissions from ethanol made from food crops such as grains and sugar are limited by the emissions of GHG during the production process. So-called 'second generation' cellulosic ethanol production technologies have the potential to dramatically improve the environmental performance of ethanol. Cellulosic ethanol is made from the stalks and stems of plants, including wheat straw, grass and even wood chips, rather than from sugars and starches in food crops such as corn. Converting this feedstock into cellulosic ethanol requires less energy, and the area of crops required per litre of ethanol produced is less than half that required when making ethanol from corn³⁰.

Cellulosic ethanol could provide reductions in GHG of up to 90% compared to unleaded petrol over the fuel life cycle³¹. While development of technologies for producing cellulosic ethanol is accelerating, large-scale economically feasible production could be still some years in the future.

As noted above, General Motors is active in promoting ethanol in the Americas and Europe. The world's largest car manufacturer recently invested in a renewable energy company aiming to establish a commercially viable facility to make ethanol from any carbon-containing feedstock, including wood chips, plant waste and garbage, by 2011³². Two hours after the announcement of this partnership, Toyota advised it was also involved in research to convert wood into ethanol. DuPont is another very large company

²⁶ RACQ Vehicle Technologies Department op. cit.

²⁷ Australian Government *Report of the Biofuels Taskforce to the Prime Minister* op. cit.

²⁸ CSIRO *Biofuels in Australia – issues and prospects* op. cit.

²⁹ *ibid.*

³⁰ Bullis, Kevin 'Will Cellulosic Ethanol Take Off?' *Technology Review* Massachusetts Institute of Technology February 2007

³¹ Commonwealth of Massachusetts *Advanced Biofuels Task Force Report* April 2008

³² Biofuels Australasia 'GM buys into cellulosic ethanol as it continues to reinvent the car' *Biofuels Australasia* March/April 2008 p 16

to recently invest in cellulosic ethanol research, partnering with the supplier of new enzymes designed to speed up the conversion process³³. Like General Motors, DuPont hopes to produce ethanol at a cost well below that of corn-based ethanol.

Much of the research effort is aimed at improving the enzymatic hydrolysis and fermentation process that is most commonly used to convert cellulose to sugars that can be fermented to make ethanol³⁴. Enzymes produced by termites and fungi are being investigated, while other research focuses on alternate microbiological processes.

Efficiencies for cellulosic ethanol production are further enhanced when waste from another process is used as feedstock. Such a process is planned for Mackay, Queensland where the Queensland University of Technology is to build a pilot cellulosic ethanol plant, in partnership with Mackay Sugar, at the end of 2008. The plant would use bagasse (the residue from sugarcane crushing) from an adjacent sugar mill as feedstock³⁵.

Another cellulosic ethanol pilot plant is underway in northern New South Wales, using sawmill wood residue and bagasse feedstock. The Director of Ethanol Technologies Limited advised that their new hydrolysis process will dramatically speed up the production of ethanol. In addition, burning the lignin co-product to produce electricity will result in a positive energy balance for the plant and almost no carbon dioxide emissions³⁶.

Genetic modification of feedstock is also being pursued in attempts to improve the efficiency of ethanol production. In one study, scientists at Michigan State University inserted a gene from a bacterium that lives inside cow stomachs into a corn plant³⁷. The gene causes the corn to produce an enzyme used by cows to convert cellulose into energy. The whole corn containing this enzyme could be made into ethanol without wasting parts of the plant and buying expensive enzymes. Another genetic approach is to produce trees that have less lignin, making it easier for the enzymes to access cellulose³⁸. Trees are regarded as useful feedstock as they can be harvested at any time and are good absorbers of carbon dioxide.

³³ Biofuels Digest 'DuPont, Genecor launch \$140 million cellulosic ethanol venture based on new enzymes' *Biofuels Digest* <http://biofuelsdigest.com/blog2/2008/05/15/dupont-genecor-launch-140-million-cellulosic-ethanol-venture-based-on-new-enzymes/> accessed 15 May 2008

³⁴ Nature Publishing Group 'Cellulosic ethanol booms despite unproven business models' *Nature Biotechnology* Vol 26 No 1 January 2006

³⁵ ABC News *Hopes for Mackey to house ethanol plant* 27 May 2008 <http://www.abc.net.au/news/stories/2008/05/27/2256492.htm> accessed 27 May 2008

³⁶ Biofuels Australasia 'Going out on a limb to find energy solutions' May/June 2008 http://www.biofuelsaustralasia.com.au/article_id=1293 accessed 29 May 2008

³⁷ Michigan State University 'Gut Reaction: Cow Stomach Holds Key to Turning Corn Into Biofuel' *ScienceDaily* April 2008

³⁸ Pollack, Andrew 'Through Genetics, Tapping a Tree's Potential as a Source of Energy' *The New York Times* November 2007

Second generation ethanol production is being promoted as a solution for a growing environmental problem associated with the expansion of the US ethanol industry. Soil scientists recommended implementation of advanced conservation measures to minimise nitrogen and phosphorous losses from corn crops being grown in the Mississippi River Basin³⁹. Nitrogen and phosphorous washing into the Gulf of Mexico causes excess growth of algae, which later dies and in decomposing reduces the oxygen content of the seawater. Consequently, a very large area of the Gulf can no longer support marine life⁴⁰. Crops identified as a potentially useful feedstock for cellulosic ethanol such as switchgrass, a perennial prairie grass, lose very little nitrogen and phosphorous compared to corn and so would reduce the impact of farming for biofuels.

Feedstock for second generation biofuels production

In Australia, second generation ethanol could provide 10-140% of current usage of petrol, depending on production methods⁴¹. The CSIRO reported use of existing feedstock would provide neutral environmental impacts, while planting of trees and shrubs for feedstock could provide improvements in salinity and biodiversity in some areas. However this could also exacerbate water yield and river salinity in other areas⁴².

The potential proliferation of species grown as feedstock for biofuels is a concern for conservation groups who warn that such crops could take over other farms and natural land nearby. These groups presented a paper to the 2008 United Nations Convention on Biodiversity pointing out that many popular cellulosic crops are also known invasive species⁴³. In particular, the giant reed proposed for planting by the European Union, and being grown in Florida, is said to be a fast growing species that reduces water supplies and damages drainage, as well as being a fire hazard. The biofuel industry countered that the giant reed is a high-yield environmentally friendly plant that will grow where other species will not.

A previous Australian study by the Invasive Species Council warning of the risk of growing invasive crops for biofuels was presented to the 'Greenhouse 2007' conference in Sydney⁴⁴. The report assessed the risks presented by 18 species promoted as biofuels feedstock. These crops are regarded as important for the Australian biofuels industry as they will grow in difficult climates and soil. However seven of these plants are banned in parts of

³⁹ Soil Science Society of America 'Fuelling Ethanol Production While Protecting Water Quality' *ScienceDaily* April 2008, <http://www.sciencedaily.com/releases/2008/04/080401112400.htm> accessed 24 April 2008

⁴⁰ Walsh, Bryan, 'Another problem with Biofuels?' *Time*, March 2008, <http://www.time.com/time/health/article/0,8599,1721693,00.html> accessed 16 April 2008

⁴¹ CSIRO *Biofuels in Australia – issues and prospects* op. cit.

⁴² *idid.*

⁴³ Rosenthal, Elisabeth 'New Trend in Biofuels Has New Risks' *The New York Times* 21 May 2008 http://www.nytimes.com/2008/05/21/science/earth/21biofuels.html?_r=1&oref+slogin accessed 23 May 2008

⁴⁴ Low, Tim and Booth, Carol *The Weedy Truth About Biofuels* Invasive Species Council October 2007 <http://www.invasives.org.au/issues/biofuels.html> accessed 23 May 2008

Australia. One of the banned species, jatropha, is being cultivated widely around the world for biofuel production. The report notes that giant reed is being trialed as a biofuel crop in South Australia despite problems of controlling the plant in California, and its listing in the World Conservation Union's list of the 100 world's worst invasive species.

Biofuels from algae

Another biofuel production process uses algae as feedstock. Research at the James Cook University in North Queensland aims to identify algae that could feed a commercially viable biodiesel plant in Townsville. The Queensland Government and MDB Biodiesel are partnering with the university to isolate suitable strains of algae from the Great Barrier Reef that could be developed to achieve high-yield production. It is hoped a demonstration plant will be constructed in 2009⁴⁵. Eventually, large-scale plants would be located next to power stations so the algae could feed on the carbon dioxide produced by the plant, and produce algal oil for biodiesel and a feedstock for animals.

Algae farms show great potential as a use for the large volumes of low-grade waste heat and water from power stations and factories. In his draft report on climate change, Professor Ross Garnaut noted that feeding carbon dioxide to algae grown for biofuels is a potentially highly valuable approach to bisequestration of carbon emissions⁴⁶.

Algae is also the feedstock for a new process that generates a biofuel chemically identical to petrol. Photosynthesis within the algae absorbs carbon dioxide and sunlight to produce a carbon molecule that can be refined to make 91 RON petrol. In addition to being renewable, the new fuel has advantages over ethanol in that it has the same energy density as petrol and could use existing tanks and pipelines⁴⁷.

Land clearing

Perhaps the major environmental issue for biofuels arises from the clearing of land to grow feedstock. The recent expansion of biofuels production, mainly driven by US and EU mandates, has resulted in the clearing of large areas of land not previously used for agriculture to grow corn or sugar for ethanol, or palm oil or soybean for biodiesel. According to studies published in the journal *Science*, the carbon released to the atmosphere due to this land clearing is 17 to 420 times that which could be saved each year by using the resultant biofuels⁴⁸.

⁴⁵ Raggatt, Tony 'Algae in your tank' *Townsville Bulletin* 27 May 2008

⁴⁶ Garnaut, Ross *Garnaut Climate Change Review Draft Report* July 2008

⁴⁷ Dolan, Kerry 'Turing Algae Into Gasoline' *Forbes* 28 May 2008

http://www.forbes.com/2008/05/28/alternative-fuels-biofuels-tech_sciences_cz_kad_0528fuels.html accessed 2 June 2008

⁴⁸ Conner, Steve 'Biofuels make climate change worse, scientific study reveals' *The Independent*, 8 February 2008, <http://www.independent.co.uk/environment/climate-change/biofuels-make-climate-change-worse-scientific-study-concludes-779811.html> accessed 8 April 2008

Even where crops are grown on farmland, the push for biofuel feedstock has indirect consequences for forests. Increased farming of corn in the US at the expense of soybean production has led to Brazilian farmers using grazing country to grow soybeans. This in turn results in cattlemen cutting down rainforests to provide pastures for their herds⁴⁹. In various articles, the promotion of biofuels as a measure to resist climate change is described as a con or a scam. Some commentators now consider biofuels to actually exacerbate, rather than mitigate, climate change.

Sustainability issues and biofuels mandates

The FIA identified concerns with possible adverse environmental effects of biofuels in its 2006 submission to the European Commission on the EU Biofuels Directive⁵⁰. The directive required that by 2010, biofuels would make up 5.75% of transport fuel supplies in the EU. The FIA submitted that biofuels are not per se environmentally friendly, and there is a need for standards on cultivation and production methods for EU and imported biofuels to ensure net benefits. The FIA argued that ecological assessments are needed especially where land has not been used for agriculture before. These assessments must consider the use of fertilisers and pesticides, and should also consider labour standards and potential exploitation.

In 2007 the EU proposed a Fuel Quality Directive that included increasing the target for biofuels to 10% by 2020, under the condition that production is sustainable and second generation technologies are commercially available. However increasing concern about the net environmental impact of biofuels culminated in recent advice from the European Environment Agency's (EEA) scientific advisory body that the 10% target be suspended pending a new scientific study on the environmental risks and benefits of biofuels⁵¹.

The EEA stated that first generation biofuel production methods are not energy efficient, and estimated that the amount of arable land available for biofuel production without environmental damage is not enough to meet the 10% target. Importation of biofuel to meet the target would result in unsustainable production in other parts of the world. The EEA considers the 10% target is overambitious and an experiment with unpredictable and uncontrollable unintended effects.

Calls for the abandonment of the EU Fuel Quality Directive have increased in the lead-up to the European Parliament's consideration of the directive in September 2008. A Green Party member from Luxembourg, who led a renewables directive through the Parliament in January 2008, urged the EU to drop the proposed 10% biofuels mandate and proposed a ban on use of

⁴⁹ Grunwald, Michael 'The Clean Energy Scam' *Time* 27 March 2008, <http://www.time.com/time/0,8816,1725957,00.html> accessed 16 April 2008

⁵⁰ The Eurocouncil of the Federation Internationale de l'Automobile *Public consultation of the European Commissions on the review of the EU biofuels directive, April-July 2006* op. cit.

⁵¹ European Environment Agency *Suspend 10 percent biofuels target, says EEA's scientific advisory body* 10 April 2008 <http://www.eea.europa.eu/highlights/suspend-10-percent-biofuels-target-says-eeas-scientific-advisory-body> accessed 23 April 2008

arable farmland for biofuels⁵². The fuel directive continues to attract controversy: while the Parliament wants to include sustainability criteria in the fuel directive, the European Commission maintains the criteria are already included in the renewable directive. The EU did agree that biofuels must deliver a life-cycle carbon dioxide saving of 35% to count towards the 10% mandate⁵³.

In addition to the Green Party opposition to the Fuel Quality Directive, a consortium of 17 non-government organisations called for strong sustainability criteria to be included in the directive. The NGO's position that sugar, corn and some types of canola and palm oil be banned as biofuels feedstock, and the carbon dioxide threshold for biofuels be 50%, won significant support in the European Parliament⁵⁴. The Parliament's own rapporteur for the new directive concluded there is 'overwhelming evidence to drop the mandatory 10 percent target of fuels from renewables'⁵⁵.

In spite of the argument over the EU mandate, the United Kingdom's Renewable Fuel Transport Obligation, which requires all petrol and diesel sold in the UK to include at least 2.5% biofuels, was introduced on 15 April 2008. At the same time, the UK Government's own Renewable Fuels Agency was producing a report on the negative impacts of biofuels⁵⁶. The Government's Chief Scientific Advisor, and the chief scientific advisor for the Department of Environment, Food and Rural Affairs had previously questioned the sustainability of biofuels. The introduction of the 2.5% biofuels mandate was marked by protests from green groups around the UK, who called for the policy to be abandoned until the impact of biofuel production can be assessed. Conservationists claimed the industry had already destroyed vast areas of habitat and had made at least one species extinct⁵⁷.

Summary of environmental issues and sustainability

The reductions in greenhouse gas emissions provided by biofuels are limited by the technical restrictions on fuel blends that can be practicably used. In addition, current production methods significantly limit the environmental performance and sustainability of biofuels. The Chief Scientist for BP, Dr Steve Koonin, considers that there are tremendous improvements necessary

⁵² Reuters *Key lawmaker urges EU to scrap 10 pct biofuel target* 16 May 2008
<http://in.reuters.com/articleId=INL1651093020080516> accessed 20 May 2008

⁵³ Biofuels Digest *European Parliament may reject 10 percent mandate, ban use of arable land as key legislator announces biofuels opposition* 19 May 2008
<http://biofuelsdigest.com/blog2/2008/05/19/european-parliament-may-reject-10-percent-mandate-ban-use-of-arable-land-as-key-legislator-announces-biofuels-opposition> accessed 20 May 2008

⁵⁴ *ibid.*

⁵⁵ New Europe 'EP wants to drop the biofuel 10% target' *New Europe*
<http://www.neweurope.eu/articles/87355.php> accessed 4 June 2008

⁵⁶ McFarlane, Sarah 'Bowing out of biofuel' *Business Spectator* 17 April 2008
<http://businessspectator.com.au/bs.nf/Article/Bowing-out-of-buiofuel-DRLT3?> accessed 21 April 2008

⁵⁷ Milmo, Cahal 'Biofuel: the burning question' *The Independent* 15 April 2008
<http://www.independent.co.uk/environment/climate-change/biofuel-the-burning-question/html> accessed 22 May 2008

in the environmental performance and sustainability of biofuels before they could make any significant impact on GHG emissions. Dr Koonin points out that with E10 providing a 2% reduction in GHG emissions, and only 21% of total GHG emissions being due to transport, there is limited potential for ethanol blends to impact on global GHG levels⁵⁸. More critically, there is just not enough feedstock in the world to produce even a 15% displacement of petroleum fuels by biofuels produced by current means.

Second generation production technologies including cellulosic ethanol and biofuels from algae have the potential to provide more than enough biofuels for real environmental gains to be made, but these technologies are far from being commercially viable.

The OECD notes that government mandates and targets do not, in most cases, distinguish between biofuels according to their feedstocks or production methods, despite wide differences in environmental performance. It is possible that government policies could support a biofuel that has a worse environmental impact than the petroleum product it replaces⁵⁹.

Economic Performance

Economic impacts of the biofuel industry, in particular government subsidies and the diversion of food crops and land for growing food to biofuels production, have become as significant to the future of the industry as environmental considerations.

Government subsidies and assistance

Some governments regard the biofuels industry to be a potential driver of economic development in regional areas, and are willing to assist the establishment of the industry through direct assistance and by encouraging or requiring the use of biofuels. The 1995 Prime Minister's Taskforce concluded that an assisted Australian biofuels industry might increase commodity prices and lead to investment in facilities in regional areas⁶⁰. However the taskforce noted these economic advantages might also bring unforeseen impacts such as increased grain prices for livestock, especially in drought. The taskforce questioned whether assisting the biofuels industry is the most cost-effective and targeted way to encourage regional development. In addition, the reductions in GHG from using biofuels alone were not considered to warrant further government assistance, given the availability of much cheaper carbon reduction options.

Possible competition for markets was also raised by the CSIRO report into the potential Australian biofuels industry⁶¹. Expansion of the ethanol industry would cause competition for crops with foods and feed grain for livestock,

⁵⁸ Knott, Terry 'Back to a bio future' *Frontiers* April 2007

⁵⁹ *ibid.*

⁶⁰ Australian Government, *Report of the Biofuels Taskforce to the Prime Minister* op. cit.

⁶¹ CSIRO *Biofuels in Australia – issues and prospects* op. cit.

while increased biodiesel production would bring competition for feedstock with soap and detergent manufactures. A large-scale biofuel industry would likely also generate competing markets for land, water and labour for production. These would impact on many industry sectors, especially in regional areas. Given the current saturation of the labour market, it is probable that filling any new jobs in biofuels would come at the expense of other employers.

Issues of competing objectives driving government assistance for biofuels were also raised in the report of the CSIRO's Future Fuels Forum, in June 2008. The Forum concluded that pursuing multiple objectives such as regional development, greenhouse gas reduction, fuel security and increasing exports without consideration of each other, and across different levels of government, is likely to produce a variety of unintended consequences⁶².

An Australian Parliamentary Library research paper published in January 2008 reviewed the findings of the 1995 Prime Minister's taskforce and assessed the economic effects of an ethanol mandate⁶³. The paper advised that while a mandate would reduce oil imports, any diversion of feedstock from exports or increased imports of feedstock needed to meet the mandate would increase the trade deficit. In addition, the costs of creating jobs under an ethanol mandate would be high, and a mandate could also adversely affect other rural industries. The paper concluded that although a comprehensive cost-benefit analysis of an ethanol mandate has not been undertaken, no prima facie economic case for a mandate has been established.

A broader study of government assistance for biofuels in general was prepared in 2008 for the Organisation for Economic Cooperation and Development (OECD), as part of a study of government assistance for biofuels in OECD countries. The study highlights the opportunity costs of government subsidies in Australia, which totalled over \$95 million in 2006-07⁶⁴. The authors question whether this level of assistance is warranted, given the relatively small environmental advantages of biofuels. For example, the report stated that the cost of reducing one tonne of CO₂ through the use of the most effective biofuel for GHG reductions (biodiesel made from used cooking oil) could buy more than 5 tonnes CO₂ offsets on the European climate exchange and 30 tonnes on the Chicago exchange.

The report for the OECD concludes that the level of assistance for Australian biofuels industry is at least as large as the value added by the biofuels produced, and much more than for other highly subsidised agricultural industries. While noting that industry assistance is sometimes needed for infant industries, the authors point out that established biofuel industries in Brazil, US and Europe require mandates and/or subsidies for decades. The report recommends that no mandates be imposed without an examination of

⁶² CSIRO *Fuel for Thought* Future Fuels Forum June 2008

⁶³ Webb, Richard *The Economic Effects of an Ethanol Mandate* Parliamentary Library Research Paper No 18 2007-08 22 January 2008

⁶⁴ Quirke, Derek, Steenblik, Ronald & Warner, Bob *Biofuels – at What Cost?* Global Subsidies Initiative April 2008

costs and benefits, and a transparent evaluation be carried out of the cost-effectiveness of support and long-term viability and competitiveness of Australian biofuels industry⁶⁵.

Subsequent to the release of the report for the OECD, the Australian Government announced a review of the grants program for the ethanol industry. The Productivity Commission had previously called for the review amid warnings ethanol production was pushing up prices of feed-grain⁶⁶. Ethanol producers consider the grants to be vital for the viability of the industry, and halted plans for expansion of production on the announcement of the review.

While reviewing grants for producers, the Government is also considering extending assistance for biofuels in the form of subsidies on excises. The subsidies were introduced in 2006 to compensate producers of alternative fuels, including ethanol and biodiesel, for the 38.14 cents per litre (cpl) fuel excise. The subsidy also applies to imported biodiesel, but not imported ethanol. Reductions to be phased in from 2011 will result in the subsidies being 12.5 cpl for ethanol and 19.1 cpl for biodiesel, by 1 July 2015.

Biofuel producers consider the excise subsidy is required to ensure the competitiveness of their industry, and ethanol producers in particular have argued for extension of the full subsidy to allow more time for their industry to develop while protected from imports of cheaper overseas-produced ethanol. Following reports that motorists are buying cheaper fuels in response to rapidly increasing prices in 2007-08, the biofuels subsidies were included in the Government's review of taxation in general⁶⁷. This review, along with the review of the ethanol grant program, is scheduled to report in the second half of 2008.

Even with subsidies and assistance, biofuels production in Australia received a setback in June 2008 when BP pulled out of an agreement to partner building an ethanol facility in Western Australia. The facility was to produce ethanol from grain, and although located in the largest grain producing state, BP saw the project as not commercially viable⁶⁸.

Biofuels mandates

Mandates are another form of assistance to biofuels producers. In its 2006 submission on the European Union biofuels directive discussed above, the FIA points out that a mandate would have the effect of using public money

⁶⁵ *ibid.*

⁶⁶ Roberts, Greg 'Ethanol grants turn sour' *The Australian* 1 May 2008 <http://www.theaustralian.news.com.au/story/0,25179.23625837-5013871,00.html> accessed 13 May 2008

⁶⁷ Taylor, Lenore 'Rethink over importation of alternative pump excise' *The Australian* 29 May 2008 <http://www.theaustralian.news.com.au/story/0,25197,23775570-5013871,00.html> accessed 29 May 2008

⁶⁸ Henderson, Peter 'WA ethanol deal runs out of juice' *The Land* 4 June 2008 <http://theland.farmonline.com.au/news/nationalrural/agribusiness-and-general/general/wa-ethanol-deal-runs-out-of-juice/782813.aspx#> accessed 5 June 2008

raised through increased prices to subsidise the biofuels industry⁶⁹. This issue has also been raised in Australia⁷⁰. The FIA considers that direct government incentives and subsidies are better mechanisms for assisting the biofuels industry.

Australian State governments have been considering biofuel mandates for some years. An ethanol mandate imposed by the New South Wales Government on 1 October 2007 requires that at least 2% of the total volume of petrol sold or delivered in that state is to be ethanol. There is also a target of 10% ethanol by 2011. This mandate is designed as an interim measure while a sustainable biofuels industry is developed.

Government support for biofuels is increasing in New South Wales, with the Premier, Mr Morris Iemma, telling a Sydney biofuels conference in April 2008 that his Government is seriously considering requiring regular unleaded petrol be replaced with E10, from 2010⁷¹. Subsequently, the New South Wales Government announced plans to double the 2% ethanol mandate in 2009, and introduce a 2% biodiesel mandate as soon as practicable⁷².

This position is at odds with developments in Victoria. The Victorian Parliamentary Inquiry into Mandatory Ethanol and Biofuels Targets concluded in February 2008 that the risks of any biofuel mandates outweigh the potential benefits⁷³. The Victorian Government is expected to release its response to the inquiry's report in August 2008.

The Queensland Government proposes by 2010 to require that ethanol makes up at least 5% of the total volume of petrol sold in Queensland. The mandate forms part of the Government's Queensland Ethanol Industry Action Plan, which will involve investment of \$7.3 million in improving consumer confidence and supply and distribution of ethanol fuel⁷⁴.

Biofuels mandates were also criticised in the Draft Report of the Garnaut Climate Change Review. Professor Garnaut noted that mandatory requirements and subsidies for the use of biofuels introduced in the United States and European countries have had 'strong effects on putting upward pressure on global food prices, with negligible environmental benefits'⁷⁵. Similar comments appeared in a report commissioned by the National Road Motorists Association (NRMA) recommending a strategy for developing

⁶⁹ The Eurocouncil of the Federation Internationale de l'Automobile *Public consultation of the European Commissions on the review of the EU biofuels directive, April-July 2006* op. cit.

⁷⁰ Webb, Richard *The Economic Effects of an Ethanol Mandate* op. cit.

⁷¹ Thompson, Ian 'Premier Puts the Foot Down' *Biofuels Australasia* May/June 2008
http://www.biofuelsaustralasia.com.au/article-print.jsp?article_id=1297 accessed 29 May 2008

⁷² Roberts, Greg 'Biodiesel mandate defies backlash' *The Australian* 6 June 2008

⁷³ Economic Development and Infrastructure Committee *Biofuels - No to Victorian Mandate* Parliament of Victoria media release 7 February 2008

⁷⁴ Queensland Government *Australia Urged to Follow Queensland's Green Fuel Lead* 28 August 2007

⁷⁵ Garnaut, Ross *Garnaut Climate Change Review Draft Report* op. cit.

alternative fuels in Australia, which commented that 'the United States corn-based ethanol program is not a good model for Australia'⁷⁶.

RACQ position on mandates

The RACQ has a long-standing position that there should not be a government mandate on the amount of ethanol sold in Queensland, and considers there are more effective mechanisms for encouraging an economically viable and environmentally friendly industry that would provide real benefits⁷⁷.

Motoring organisations around the world, including the RACQ, support the FIA Make Cars Greens campaign that includes a voluntary target for carbon dioxide emissions for passenger cars of 140 grams per kilometre. The campaign, launched in June 2008, does not rely on any particular technology or fuel for making environmental improvements. In that way, the most effective, efficient and economically viable solutions can be adopted, and undesired impacts minimised. Adoption of the non-mandatory emissions target also forms a recommendation of the AAA submission to the Australian Government's 2008 Review of the Australian Automotive Industry⁷⁸.

Non-technology specific targets were adopted by the governments of California and Massachusetts in their low carbon fuel standards. These performance-based standards also set limits on GHG emissions, without mandating fuel content. This allows the market to drive the development of fuels at the lowest cost, and allows the best approaches to reducing the environmental impacts of vehicle transport to be adopted⁷⁹.

The European Federation for Transport and Environment also supports targets for cutting GHG emissions. In a letter to *The Economist*, the Federation's Director warns against volume targets for biofuels that would boost production and sale of biofuels regardless of their environmental performance. That answer, he says, lies in making cars more fuel-efficient, thereby cutting emissions no matter what fuel is used⁸⁰.

The OECD supports the adoption of technology-neutral policies over mandates that require specific fuels or power trains. Governments should phase out existing fuel mandates, says the OECD, in favour of policies that will stimulate market incentives for more efficient technologies⁸¹.

⁷⁶ NRMA *A Roadmap for Alternative Fuels in Australia* Report of the Jamison Group to NRMA Motoring & Services July 2008

⁷⁷ RACQ *Proposed Ethanol Mandate for Queensland* May 2008

⁷⁸ Australian Automobile Association *AAA Calls on Bracks Review to Make Cars Green* 4 June 2008

http://www.aaa.asn.au/publications/media_releases.php?action=view&media_releaseld=352 accessed 17 June 2008

⁷⁹ Commonwealth of Massachusetts *Advanced Biofuels task Force Report* Spring 2008

⁸⁰ Dings, Jos 'Biofuels and advertising' *The Economist* 5 July 2008

⁸¹ Doornbosch, Richard and Steenblik, Ronald *Biofuels: is the cure worse than the disease?* OECD op.cit.

Energy security

Aside from regional development, the major rationale quoted by governments when promoting or mandating the use of biofuels is to ensure the security of fuel supplies in the long term. Recent substantial increases in the price of oil and discussions on whether world oil supplies are now decreasing has led governments, especially in the United States, to rely on biofuels to provide greater domestic fuel security. However, successive studies have concluded that an Australian biofuels industry would not provide energy security^{82,83,84,85}. The CSIRO determined, based on 10 years feedstock data and assuming the upper limit of biofuel production, that wheat and coarse grains could have made enough ethanol to provide 11 to 22% of petrol usage in 2007. Waste oil, tallow and oilseed could have provided biodiesel sufficient for 4-8% of the diesel usage⁸⁶.

The CSIRO concluded that given the nature of Australia's growing cycles and droughts, the large-scale biofuel production necessary to provide some measure of energy security would place a great strain on feedstock production. More recently, the farming industry warned that ethanol mandates would lead to critical shortages of grain, as current production plants use feed-quality grain as feedstock⁸⁷. Although the NSW Minister for Regional Affairs stated that only waste from flour and starch making is used to produce ethanol, the Managing Director for Manildra, which supplies ethanol to meet the NSW mandate, told the Victorian inquiry into biofuel mandates that as much as half the feedstock at his plant was feed-quality grain.

In her response to the RACQ's concerns about the proposed Queensland ethanol mandate, the Minister for Tourism, Regional Development and Industry conceded that there is a risk that an ethanol mandate could contribute to price rises in a drought year. However the Queensland Government would monitor the availability of feedstock and respond accordingly⁸⁸.

Biofuels and food shortages

Rising oil prices, changes in diets as populations in countries such as China and India become more affluent, climate impacts including drought in Australia and the diversion of crops to biofuel production have combined to drive dramatic increases in world food prices. For example, the global price of wheat has risen 130%, and rice by 74% over the last year⁸⁹. The United Nations advised that 36 countries are facing a food crisis due to rising prices.

⁸² Australian Government *Report of the Biofuels Taskforce to the Prime Minister* op. cit.

⁸³ CSIRO *Biofuels in Australia – issues and prospects* op. cit.

⁸⁴ Webb, Richard *The Economic Effects of an Ethanol Mandate* op. cit.

⁸⁵ Quirke, Derek, Steenblik, Ronald & Warner, Bob *Biofuels – at What Cost?* op. cit.

⁸⁶ CSIRO *Biofuels in Australia – issues and prospects* op. cit.

⁸⁷ Roberts, Greg 'Push for ethanol hits grain supplies' *The Weekend Australian* 31 May 2008

⁸⁸ Boyle, Desley letter to Ian Gillespie, CEO RACQ op. cit.

⁸⁹ Valley, Paul 'The other global crisis: rush to biofuels is driving up price of food' *The Independent* 12 April 2008 <http://www.independent.co.uk/news/world/politics/the-other-global-crisis-rush-to-biofuels-is-driving-up-price-of-food/html> accessed 22 May 2008

As a result, people in many of the world's poorer nations are facing famine and demonstrating against food prices and shortages. Richer countries are also seeing unprecedented rises in food prices.

Opinions vary considerably on the extent to which biofuel production exacerbates global food shortages. Proponents of the industry point out that the corn used for ethanol production, is not of a standard fit for human consumption. However other commentators report that the diversion of this corn from livestock production leads to use of human food to feed animals, meaning less food for people, and higher prices of meat⁹⁰.

Food scientists pushing for a biofuel moratorium say that stopping the use of biofuels would lead to a decrease in corn prices by 20% and wheat by 10%. The US Department of Agriculture estimate that biofuels are responsible for about 20% of the rises in price, while President Bush said the figure is 15%. The International Food Policy Research Institute blames biofuels for 30% of the increase, but an industry-funded study quotes a contribution of only 4%⁹¹. According to the World Bank, the US ethanol program is the major factor in an increase in corn prices of 60% from 2005 to 2007⁹².

In December 2007 President Bush signed the Energy Independence and Security Act, which requires that from 2022, 36 billion gallons of ethanol be produced in the US every year. This is nearly five times the US production of ethanol in 2007. But the world food crisis and increasing domestic food prices prompted 24 Republican senators, including presidential candidate Sen John McCain, to request the US Environmental Energy Agency waive or restructure the ethanol mandate⁹³.

In spite of growing concern internationally and within the Republican Party, the US Administration remains firm in its support for the biofuels industry, in particular ethanol producers and their suppliers. On the eve of the Rome UN food crisis summit in June 2008, the US Agriculture Secretary controversially claimed biofuel production only contributed 2 to 3 % of the rise in global food prices. This contradicts a recent International Monetary Fund estimate of 20 to 30% of food price increases in the last two years being the result of the biofuels industry⁹⁴.

There is also disagreement within the UN, on the role of biofuels in the current food shortage. A UN special rapporteur famously called biofuels 'a crime against humanity', but the UN Secretary-General, Ban Ki Moon, continues to

⁹⁰ *ibid.*

⁹¹ Borenstein, Seth *Food scientists say stop biofuels to fight world hunger* Associated press 29 April 2008 http://ap.google.com/article/AleqM5g6hbT75_thXF6CITBPcgoFsLSvIAD90BP6RGO accessed 26 May 2008

⁹² *Ibid.*

⁹³ Perrone, Matthew *Senators call for EPA to reconsider ethanol output mandate* Associated Press 6 May 2008 <http://ap.google.com/article/AleqM5iybC7Vg-hYUTo1JobqHB1KvS0ZpwD90FJD780> accessed 7 May 2008

⁹⁴ Borger, Julian 'US biofuels subsidies under attack at food summit' *The Guardian* 3 June 2008 <http://www.guardian.co.uk/environment/2008/jun/03/biofuels.energy/html> accessed 4 June 2008

support biofuels as a solution to climate change and a renewable energy source. Nevertheless, the Secretary-General acknowledged there is a need to be concerned about biofuels taking arable land and called for governments to review their policies on biofuels⁹⁵.

The Secretary-General's comments were echoed by the head of the secretariat for the UN Framework Convention on Climate change, who acknowledged that a review of policies on replacing biofuels would be prudent.⁹⁶ The UN Food and Agriculture Organisation (FAO) advised a Canadian Senate committee investigating biofuels mandates that while energy costs and poor growing seasons were the main cause of rising food prices, governments should be aware of the effects on world markets of any biofuel mandates⁹⁷.

While advising that world food prices have been gradually decreasing, both the OECD and the FAO expect prices over the next 10 years to exceed the averages over the last decade. The Agricultural Outlook provided by the organisations noted that world ethanol production tripled between 2000 and 2007 and is expected to double again in the next 10 years. Biodiesel production is expected to more than double in the same period. The Outlook concludes that this growth is driven by policy measures and it is not clear that the energy, environmental and economic objectives of these policies will be achieved with current production technologies⁹⁸.

In June 2008 the United Nations called an emergency conference on food shortages, climate change and energy, with the impact of biofuels on food supplies one of the main issues for discussion. At the opening of the summit, the Head of the FAO criticised global policies that he said favoured the west and, indirectly, the US program of farm subsidies and the diversion of crops to fuel vehicles⁹⁹. The conference was dominated by leaders drawing attention to their own country's issues and arguments on protectionism and biofuels. While Ban Ki-moon aimed to address the need for a balance between energy needs and food security in order to ensure biofuels are sustainable, the final resolution of the conference merely called for more research on biofuels¹⁰⁰.

⁹⁵ Borger, Julian 'UN chief calls for review of biofuels policy' *The Guardian* 5 April 2008 <http://www.guardian.co.uk/environment/2008/apr/05/biofuels.food/html> accessed 15 May 2008

⁹⁶ PR-inside.com *UN climate chief says biofuels necessary in future* 22 May 2008 <http://www.pr-insoide.com/un-climate-chief-says-biofuels-necessary-in-future-r604112.htm> accessed 26 May 2008

⁹⁷ Palmer, Randall 'FAO sees energy, biofuel keeping world food costly' *The Guardian*, 15 May 2008 <http://www.guardian.co.uk/business/feedarticle/7518637> accessed 19 May 2008.

⁹⁸ Organisation for Economic Cooperation and Development *OECD and FAO see agricultural commodity prices remaining high and growing more volatile* 29 May 2008 http://www.oecd.org/document/29/0,3343,en_2649_201185_40717917_1_1_1_1,00.html accessed 2 June 2008

⁹⁹ Borger, Julian 'US biofuels subsidies under attack at food summit' *The Guardian* op. cit.

¹⁰⁰ Rosenthal, Elisabeth and Martin, Andrew 'Leaders speak of Their Own Issues at a Conference Addressing Food Shortages' *The New York Times* 5 June 2008 <http://www.nytimes.com/2008/06/05/world/05food.html?> accessed 6 June 2008

The Future for Biofuels

Biofuels have an uncertain future as an efficient, viable and sustainable alternative to petroleum fuels. Government policies that aim to assist the industry by requiring biofuel use may drive demand, but cannot ensure supply. For example, food shortages and floods combined in mid 2008 to raise the US corn price to the extent that many ethanol plants may be closed until production is again economically viable, threatening the ability of the ethanol industry to meet demands of the US Government's biofuels mandate¹⁰¹.

The insecurity of crop-based biofuels production may be eventually countered by emerging second generation technologies such as cellulosic ethanol and biodiesel produced from algae. As discussed above, these technologies are some way from being proved to be commercially viable. Aside from technical production issues, there are also questions about the sustainability and viability of providing sufficient feedstock for these processes.

Viability of production is not the only major issue for the industry. If biofuels of any origin are to be used sustainably in concentrations that will have a real benefit, they need to be sourced and utilised locally rather than being stored, transported, blended and distributed to consumers using the existing petroleum fuel infrastructure. In addition, the lower energy density of biofuels and other chemical properties increase the volume of fuel required and make them a less than ideal substitute for fossil fuels¹⁰².

To be sustainable, the biofuels industry needs to avoid negative environmental and societal impacts. The issues to be resolved include water resources availability, biodiversity, forest conservation, employment, communities and land rights, and environmental protection of water, soil and atmosphere¹⁰³. Government policies for driving the industry must balance environmental, energy security and regional development goals to minimise negative impacts. Mandates that prescribe use of particular fuels are unlikely to achieve this balance. Instead, standards on carbon emissions for vehicles and/or fuels would achieve the critical environmental imperatives leaving the significant market forces involved to develop a sustainable and economically viable industry.

¹⁰¹ Biofuels Digest *Corn futures over \$8 per bushel: 'Washington may have to suspend or reduce the renewable fuel standard', analyst warns* 17 June 2008
<http://biofuelsdigest.com/blog2/2008/06/17/corn-futures-over-8-per-bushel-washington-may-have-to-suspend-or-reduce-the-renewable-fuel-standard-analyst-warns/> accessed 18 June 2008

¹⁰² Knott, Terry 'Bringing on Biofuels' *Frontiers* December 2007

¹⁰³ *ibid.*

Conclusion

It is ironic that a renewable alternative energy source is itself in danger of being unsustainable. The rush to embrace biofuels as a means of securing energy supplies and reducing the environmental impacts of petroleum production and use has resulted in significant unintended consequences.

Policies that require the use of biofuels for transport have outstripped the world's capacity to efficiently produce the required fuel. It is possible that the enormous investment being made in second generation processes to produce biofuels will result in a truly sustainable industry over the next decade. In the meantime, there is a growing acceptance that the policies of developed nations striving for energy independence are at least exacerbating food supply shortages in poorer countries.

Commercialisation of new technologies is also required to realise the potential environmental benefits of biofuels. Significant reductions in GHG emissions can be achieved through the use of high-percentage ethanol blend petrol produced by cellulosic processes. The use of agricultural or even domestic waste as feedstock rather than non-food plants, and using waste materials from the ethanol production for energy generation or animal food supplies could enable a net carbon reduction from the ethanol industry. Meanwhile, emerging technologies that could convert algae to ethanol, biodiesel or even compounds chemically identical to petrol, have the potential to revolutionise the energy industry.

It is important that policies and programs to drive the uptake of new biofuel technologies, as well as those related to current products, are considered as part of overall energy strategies. Policies that focus on just one part of the renewable energy industry, such as mandates on the sale of ethanol, have proven to produce undesirable consequences that negate the positive effects of the policy. Approaches such as the FIA target on carbon dioxide emissions for passenger vehicles and the low carbon fuel standards adopted by California and Massachusetts, which do not mandate the use of specific technologies or fuels, allow markets to provide the most effective means of achieving policy outcomes.

In Australia, as in other countries, the biofuels industry is provided with significant government assistance to ensure its viability. Governments justify this assistance in part as a means of supporting regional development. However several studies have questioned the effectiveness of this approach.

Government policies on biofuels need to be reconsidered as part of broader programs for industry assistance, environmental protection and energy security. The current policies of governments in the United States, Europe and the United Kingdom are being heavily criticised for their role in supporting an unsustainable industry, and the Australian Government is reconsidering its assistance program. Under the current policies, it is questionable whether advancements in biofuels production will ensure the long-term viability of the industry before governments are pressured into reducing their support.