Submission by CSR Ethanol to Senate and Rural and Regional Affairs and Transport Committee.

Inquiry into Australia's future oil supply and alternative transport fuels.

CSR Ethanol Ltd is a fully owned subsidiary of CSR Ltd, a diversified ASX listed company. Originally founded in 1855 as a sugar company, CSR is one of Australia's oldest companies, with a proven record of consistent returns and strong cash flows from its well-established continuing assets. CSR's revenues are approximately A$2 billion a year and the groups companies employ approximately 5,900 people.

CSR Limited (CSR) is one of Australia's leading manufacturing companies with operations throughout Australia as well as in Asia and New Zealand. Through its three principal businesses, CSR is a leading supplier of building products and sugar and holds an effective 25% interest in the Tomago aluminium smelter, Australia's second largest smelting operation. CSR is also developing a number of former industrial sites for future land sales. Each of the CSR group's businesses has leading or established positions in its target markets. CSR Ethanol Ltd forms part of the sugar division and has been producing ethanol in Australia for over 100 years.

The company operates a distillery in Sarina, North Queensland, producing 60 mlpa of hydrous ethanol from molasses, a by-product of sugar milling. A second polishing unit is based in Yarraville, Victoria where hydrous product is upgraded for sale to the pharmaceutical and alcoholic beverage market. This factory also produces anhydrous fuel grade ethanol for sale into ethanol/petrol blends, which are currently retailed through over 160 service stations in South Australia, Victoria, ACT and New South Wales.

CSR recently announced a $15m project to produce fuel grade ethanol at its Sarina distillery. This facility will use the latest molecular sieve technology and will have capacity of 32 mlpa of fuel grade ethanol. The project received assistance from a Federal Government Biofuels Capital Grant of $4.16m and a Queensland State Government Grant of $250k to assist with the engineering and introduction of new technology under the Sugar Industry Innovation Fund.

The fuel ethanol market today is embryonic and CSR welcomes the opportunity to make comment to this inquiry.

1. A strong political will is needed to develop alternative fuels..

   The average Australian motorist or transport company has never experienced a real threat to fuel supplies. While there have been regional and temporary fuel shortages due to industrial action, refinery breakdowns etc, the whole supply chain has never been threatened. Alternative fuels have therefore never been foremost on the minds of Australian politicians

The US has had a different experience and consequently is seeking more independence for its fuels, including liquid fuels and to this end the President announced increased targets for self sufficiency in his recent State of the Union address. Currently the US imports 64% of its oil and this is projected to increase to 77% by 2025. This has stimulated demand for fuel ethanol which is growing exponentially. The US is building one corn based distillery per month to produce ethanol for motor vehicles. Production has now exceeded 14blpa – equivalent to about 80% of Australia's petrol demand. All told, investors, including Bill Gates are planning to spend over $US2.6b increasing US ethanol capacity by 40%.

2. Global Oil Supply will Peak.

Many observers have made predictions about the future supply/demand balances for crude oil. There is a substantial range of views about reserves, let alone predictions about demand growth. The President of ExxonMobil Corporation was recently quoted as saying crude prices today reflect a $20/bbl premium due to risk. Refined products reflect this plus an additional burden from a global shortage of refining capacity. The capacity shortfall will be fixed in time as new investment comes on stream in the Middle East, China and India.

However it is a brave soul who tries to forecast the price of crude in the long term or indeed the risk premium.

Whether we believe the forecasters from the International Energy Agency, American Petroleum Institute, or those of The Oil Depletion Analysis Centre, for the purposes of this inquiry may not matter all that much. We don't know who will get the predictions right or who is more correct than anyone else – they all have a case to make. However, what is clear, is that the world must prepare itself for declining crude oil availability and Australia needs to consider its future liquids fuel future.

3. Australia has liquid fuel options well into the future, but at what cost?

The Prime Ministerial Task Force on Renewable Fuels addressed the drivers to develop the renewable liquids fuel markets in Australia. The report concluded that the Government's Biofuels target of 350mlpa would be met by 2010. CSR supports this view. However the government's target is but a drop in the ocean. The transport fuel market in Australia comprises 18blpa of gasoline and 13bla of diesel. The biofuels target is a start, but Australia needs to consider how we move forward under a peaking oil scenario.

Australia is well endowed with hydrocarbon resources. However our crudes are light and are in decline, necessitating growing imports of material to match our refining configurations. Pressure on our crude balances will continue. Our crude oil production has peaked and there is little or no prospect of Australia ever becoming self sufficient.

Fortunately Australia has significant gas fields and gas can be used as a transport fuel eg compressed natural gas or converted to diesel (GTL technology). Liquid fuels can be derived from shale oil and coal. However as we step away from crude and move to other sources of liquid fuels the cost of producing the fuel increases due to higher capital and operating costs due to more intensive processing. Production efficiency declines resulting in stronger contributions to Greenhouse Gas formation. Engine technology and engine choice will need to be modified as the nation switches fuel types. Changes to supply chain logistics will also be required. The oil infrastructure was developed over a long period of time, so these events will not occur overnight. The committee should examine economic pathways which could inform future directions and choices for Australia.

Under a peaking scenario, renewable fuels will become increasingly attractive and competitive with conventional, or indeed non crude based alternatives.

Arguments that Australia can export its gas and coal in exchange for crude oil have some validity in a world at peace. However the largest reserves of crude oil are in countries seen to be less stable. The EU and the UK are particularly sensitive to the depletion of their own gas fields with increasing dependency on Russia. Gas has run short, or when in dispute simply cut off and it has seen a dramatic price escalation in the US. The US economy is no longer based on $2 gas. Prices are triple that with peaks up to 8 times the traditional gas price. Australia is right to be considering its supply risk and taking some early steps down the path of self sufficiency.

Many hold out hope for the hydrogen economy. Most observers would view this as decades off while R & D solves the issues of storage and fuel distribution. Hydrogen today is an energy intensive product of the hydrocarbon industry. However we would point out that ethanol itself is a significant carrier of hydrogen and may have a role in hydrogen economy in the longer term. Our view is that hydrogen is unlikely to play a significant role as a mainstream fuel for over 30 years.

4. Renewable fuel and the role of ethanol

Ethanol has been used as a fuel for internal combustion engines since 1826. Its use in Otto engines was documented in 1860 and Henry Ford had fuel flex vehicles - the T-model and became involved in building distilleries. The story of ethanol and Brazil is well documented and the US is adopting a strong policy position on ethanol. We can supply further information on these programs if required, although it has been well documented by others.

Ethanol can be thought of as a form of solar energy. Sugar cane is one of the most efficient solar absorbing plants on the planet. Suns rays are absorbed by the plants and are converted into sugars and starches which are readily fermentable to ethanol.

Today the technology to fuel vehicles with ethanol is commercial, well demonstrated and cheap. The Australian motor vehicle fleet does not have these flexible technologies, although they could be acquired rapidly and inexpensively. Brazilian fuel flex vehicles can use anything from no ethanol to 100% ethanol and

blends in between. Seventy three per cent of new vehicles sold in Brazil today are flex vehicles. This has opened up the market to a point where the Brazilian motorist with a fuel flex vehicle can decide at any time which fuel to purchase. If pure ethanol is cheaper than the 25% ethanol blend (straight gasoline is not available in Brazil) they buy pure, if not, the blend. This has opened up the ethanol market to the point where ethanol can be priced above or below blends to meet the supply side of the market. Further market flexibility has developed where the base level of the ethanol blend is also adjusted depending on supply/demand balances. The Brazilian sugar industry structure is such that the sugar mills can arbitrage their ethanol production against sugar price, switching their manufacture to the product that provides the highest returns. This is no doubt contributing to the higher sugar prices seen in markets today. (Sugar recently hit highs of 18c/lb – up from the 5 c/lb when the Australian industry commenced restructuring, although it is no where near as high as the peaks of 57c/lb reached during oil shock 1). Some question whether this will lead to the price of sugar being set by the price of oil in the long run.

The US alternative fuel market has evolved somewhat differently where the US technology flex fuel vehicles can use between zero and 85% ethanol. This again depends on availability, but gives the producers and consumers price choices in a large, growing and liquid market. The US has a different production model from Brazil, whereby its ethanol is produced from corn and to some extent sorghum.

Europe and the UK are targeting 5% ethanol in fuels as a way of addressing issues such as renewables, cleaner fuels, greenhouse gas mitigation and diversification of liquid fuel sources. Asia too, with a growing fuel demand and increasingly expensive imported hydrocarbons is also embracing ethanol, with programs in various stages of development in India, Thailand, China and Japan.

The world is becoming increasingly involved in renewable fuels and there are different drivers in each economy. For some it is trade balances and foreign exchange, for others there is a strong element of supply security. Common to all are the potential environmental benefits with a cleaner burning greenhouse positive fuel (5% carbon positive vs gasoline for the CSR Sarina facility for instance) with lower particulates emissions leading to potentially positive health outcomes.

5. A greater role for ethanol in liquid fuels in Australia.

The Federal Government established a fuel standard for petrol which permits up to 10% of ethanol to be blended with petrol. To help grow the industry, ethanol was granted a producer subsidy equivalent to fuel excise until 2011. After that excise phases in at a rate of 2.5cpl per year until ethanol is excisable at 12.5cpl from 2015. Fuel ethanol imports are likely to become competitive post 2011, when excise commences.

The Australian market in 2006 will have a total fuel ethanol production capacity of 135mlpa lead by Manildra (wheat derived) and CSR (molasses based). Dalby Bio Refinery Limited have announced the first new distillery in several years and

are shortly expected to commence construction of a 40mlpa distillery, based on sorghum. If fuel retailers were to convert all fuel to E10, the potential market in gasoline would be 1.8blpa. Clearly there is plenty of potential for new facilities if the market evolved to even this rather modest position.

What would be necessary to realise this modest potential of fuel ethanol?

There are 4 major factors which determine the attractiveness of an ethanol project under current policy settings and price regimes.

A: Raw Materials

Raw materials represent the largest cost input to the production of ethanol.

Ethanol is produced by the action of yeast on fermentable sugars. Any product which contains starch can produce ethanol by conversion of starch to sugars which can then be fermented to crude ethanol.

However, not all such raw materials are economically viable – either yields are too low or the product has too high a food value eg potatoes.

Studies in Australia conducted by Sugar Research Institute ("Ethanol from Sugarcane" by GE Bullock, Dec 2002) identified the relative attractiveness of different feedstocks for fermentation of ethanol.

Our own analysis has examined direct fermentation of sugar, molasses, sugar beet and grains - primarily sorghum and wheat.

The Australian exported sugar crop is about 5million tonnes pa. Theoretically fermenting all the exports would produce 3 bla of ethanol. However it is our view that sugar is too valuable as sugar under current and historic scenarios, relative to the price or likely price of oil (or more specifically gasoline) to be viable as a source of fuel ethanol. CSR has invested in technology which has the potential to substantially increase the yield of sugar in cane varieties. This is currently in field trials and is unlikely to be commercial until 2012. However should this be successful it has the potential to lower the cost of sugar production significantly, opening the possibility to economically produce fuel ethanol from sugar.

Molasses, a by-product of sugar recovery, has been used for over 80 years in Australia as an attractive material for fermentation. Australia exports of molasses vary depending on the size and condition of the sugar crop, but can be as high as 400kta, which could theoretically be use to produce about 100mlpa of ethanol. The reality of molasses though, is that it expensive to transport and it is not produced in quantities large enough at one site to economically produce ethanol (Distilleries in the US today have capacities of over 300mlpa of ethanol – an Australian plant needs to be at least 80mlpa capacity to capture scale benefits). So it is unlikely that molasses will supply the industry.

This leaves grain as the most attractive feedstock for the production of ethanol today. Australia has significant production of sorghum, the preferred grain for fermentation, and wheat as the most attractive raw materials. Corn is the preferred grain in the USA, but is not grown on a wide enough scale in Australia. Grain

products can be forward traded and hedged, reducing risk. They are available in large quantities. Criticism has been levelled at the use of grain in large quantities as a source for ethanol. A considerable amount of grain is used for animal feed and fermentation would remove this from the market. The amount of farm land in Australia is limited and with land clearing practices changing, it is unlikely more productive land for fuel crops will be developed. Fuel will have to compete with human and animal needs – a debate that will develop over the longer term as the industry develops. However sorghum is grown only as an animal feed and it is unpalatable to humans. Wheat for fuel use is generally lower grade wheats, also used for animal feed. High grade food wheats are generally considered as too expensive for fermentation. Grain fermentation only consumes starch, leaving behind a high value animal feed supplement (distiller's grain) which is rich in protein, minerals, fat and fibre and is highly sought after by dairy and animal feed lots. This is widely practised in the USA.

A simple analysis of grain suggests that Australia could meet a 10% blend ratio for petrol if sorghum and wheat fermentation was practised. According to a report by LECG "Economics of a Queensland Ethanol Industry" commissioned by the Queensland Department of State Development, up to 364kta of sorghum is exported annually, depending on the season. This could yield 165mla of ethanol. Total sorghum production in Australia is 2mta, which could yield 800mla of ethanol. However this represents about 10% of the wheat crop of 20mta. Thus if we consumed the total wheat crop in Australia for fuel ethanol we could produce 8blpa of fuel ethanol – about 50% of our petrol requirements. Of course we are not going to trade our daily bread for petrol which is what this scenario would suggest. However there is significant potential between the Biofuels target of say 0.2bla and the 9blpa potential of grain.

Overall it would not be unrealistic to foresee sufficient bioethanol to satisfy a 10% national average blend from domestic production.

B: Realised ethanol price

In the long run it is likely Australian ethanol producers will have to meet competition from imports. This is particularly the case once excise begins to be phased in in 2011. The largest exporter in the world is Brazil, but as the US further develops its capacity it could from time to time have surplus capacity to put into world trade. Import price will be a function of grain prices in the US, sugar price and costs in Brazil and freight and handling and exchange rates. In turn the alternate for US and Brazilian producers will be gasoline – in other words export ethanol could sell at a price equivalent to fuel markets in their country of origin. Australian ethanol producers will face either the value into the local fuel market or the alternate of imports (again with some price relativity to gasoline). Intuitively an Australian producer ought to be able to compete domestically with imported ethanol, in a perfectly transparent world without market distortions. When a product is in surplus, marginal economics and other local factors or market distortions can often dictate different price setting mechanisms.

The other pricing factor is the price of gasoline in Australia (largely driven by crude price and refiner's margin).

Because the Australian fuel ethanol market is an emerging market and that in relation to alternative fuels we are looking some years hence, it is difficult to say exactly how the market will behave in a post excise regime.

Along with price goes volume and the needs of retail customers. Assuming the Biofuels target is met and consumer confidence is not an issue, the development of the market and demand will be a function of supply economics, crude price and the attractiveness to the retailers, of marketing E10. There may be a need for policy intervention in the long run if the market does not continue to develop and it is in the public interest to further develop alternative fuels and self sufficiency.

C: Co-product sales and values

All fermentation processes have co products production. The quantity and value of co-products greatly influences the profitability of a distillery operation. Co-product markets can be as important as those for ethanol itself.

In the case of sugar and molasses, the co-product is known as dunder. Dunder has high value as a source of potassium and CSR now blends this with phosphorous and nitrogen in the form of liquid fertilisers which are injected as liquids back into cane land. Use of precision agriculture allows optimal application and greatly reduces, almost eliminating, any issues with fertiliser run off. As with molasses these liquids contain large quantities of water and are not economic to either dry or transport over long distances. This limits the locations for the installation of molasses based distilleries, notwithstanding the earlier issues associated with moving the molasses feedstock.

Grain fermentation, using established technologies also produces co–product, known as distillers grains. These can be wet or dry – wet having a short shelf life and dry being able to be more readily stored and transported. The disadvantage of dry grains is that they require energy for drying, meaning that ideally a distillery should be co-located with a gas pipeline.

Markets for the dry distillers grains are found around feed lots, dairies, piggeries, poultry farms and range fed cattle farms as a diet supplement. Once again there is a balance between the economics of transport of distiller's grains and fresh grain to the distillery. Markets for the co-product need to fit the size of demand for ethanol.

To our knowledge there has been no comprehensive study looking at the national possibilities and limitations on co-products and the impact this could have on the potential size of a grain based ethanol industry in Australia.

D: Cost of construction of distilleries in Australia

The USA is building one grain (corn) based distillery a month – this was before George Bush's State of the Nation address. It is expected that this rate of construction will continue or increase as the US moves towards increased self

sufficiency. The design, contracting, construction of distilleries is a mature industry in the USA. Consequently the facilities cost about 1/3rd the price to build in the USA than in Australia. If the industry is to be competitive in Australia the cost of plant disadvantage needs to be reduced. Brazil, while it has a different process, can also build distilleries for a fraction of the cost of Australia.

As the industry in Australia matures the cost of plants should decline, but in Australia the early movers, who are entering the industry today will bear a disproportionate cost for their facilities. The producer subsidy will expire before Australia gains critical mass in this field. If the industry stalls, this policy setting may need further consideration depending on market conditions at the time.

6. Benefits of further development of fuel ethanol

This topic was canvassed in the "Report of the Biofuels Task Force to the Prime Minister"

Due to the feedstock and co-product requirements ethanol plants are inevitably based in regional areas. New investment will strengthen the infrastructure and social fabric in rural communities. They create higher skilled jobs and bring new skills.

Furthermore these facilities provide opportunities to value add to grain exports, something Australians have always aspired to do. This is an opportunity to value add to commodity exports and thereby substitute imported hydrocarbon fuels.

7. Future pathways for renewable ethanol

Much has been made of ligno–cellulosic routes to ethanol. The US Department of Energy has invested several hundreds of millions of dollars in research into this area. The opportunity is to break down wood and wood waste eg forest residues, timber processing wastes, cane trash and leaves, wheat straw, municipal green waste and other cellulosic materials, such that the products can be fermented. The most promising research is to use enzymatic routes. However the cost of enzymes is still too high for these processes to be viable. It is not expected that there will be significant breakthroughs in this area for at least 5 to 10 years. Should this route be developed it could open up new and cheaper pathways for ethanol. Richard Branson has established Virgin Fuels with the aim of producing ethanol, including production from lignocellulosic waste. Australia should be closely watching the development of these technologies to improve the production potential of local manufacture.

An established grain based industry will improve its efficiencies over time. Breeders will look to develop grains which increase fermentation yields and farmers will select the most appropriate varieties and shift from traditional plantings.

8. Summary

Australia should be considering future alternative liquid fuels notwithstanding its rich endowments of fossil fuel.

Fuel ethanol can play a significant role in providing liquid fuels. It has advantages in that it is renewable, has environmental benefits and it is secure.

Australia produces insufficient agricultural products with today's yields to become even close to self sufficient in ethanol as a total replacement for petrol. Ethanol will only be part of the solution.

The development of the industry beyond the government's 2010 objective will depend on a number of factors:

- price of gasoline (crude and refiner margins)
- cost and availability of raw materials
- import competitiveness
- cost of plant construction
- excise regime and other policy settings

Technology will evolve over the next decade to deliver higher yielding plant species and may deliver an economic pathway from ligno-cellulosic raw materials.

Australia should be considering options for renewable fuels beyond the 2011 target.