

### 7. Diesohol

#### 7.1 *Background*

Diesohol is a fuel containing alcohol that comprises a blend of diesel fuel (84.5%), hydrated ethanol (15%) and an Australian developed emulsifier (0.5%). Hydrated ethanol is ethyl alcohol that contains approximately 5% water. The emulsifier is an important component in the preparation of the fuel. It has been developed in Australia by APACE Research.

In this chapter we examine ethanol (and hence diesohol) from wheat starch waste, as the buses that were tested in the diesohol tests whose results were used for the tailpipe emissions used diesohol with the ethanol made from wheat starch. However, we also present results that compare diesohol emissions with ethanol made from a range of different feedstocks.

#### 7.2 *Full Fuel-Cycle Analysis of Emissions*

##### 7.2.1 *Greenhouse gas emissions*

Figure 7.1 depicts the greenhouse gas emissions estimated for ethanol and diesohol. These are shown as emissions on an energy basis, as emissions on a per tonne-km basis for trucks, and on a per passenger-km basis for buses. We have used data from Apelbaum Consulting Group (1997) for the passenger task and the freight task in Australia and taken the mean energy intensity for the Australian freight task to be 1.2 MJ/tonne-km (Apelbaum Consulting Group, 1997: p.118), and the energy intensity of buses to be 1.06 MJ/passenger-km (Apelbaum Consulting Group, 1997: p.116).

As may be expected, the addition of 15% of a renewable fuel, such as ethanol, to diesel reduces greenhouse gas emissions.

##### 7.2.2 *Particulate matter emissions*

Figure 7.2 depicts the particulate matter (PM10) emissions estimated for diesel fuels. These are shown as emissions on an energy basis, as emissions on a per tonne-km basis for trucks, and on a per passenger-km basis for buses using the same energy intensities previously noted. Particulate matter emissions using diesohol are lower than those using LSD.

##### 7.2.3 *Emissions of oxides of nitrogen*

Figure 7.3 depicts the oxides of nitrogen (NO<sub>x</sub>) emissions estimated for diesel fuels. These are shown as emissions on an energy basis, as emissions on a per tonne-km basis for trucks, and on a per passenger-km basis for buses using the same energy intensities previously noted.

NO<sub>x</sub> emissions of diesohol are lower than NO<sub>x</sub> emissions of LSD.

##### 7.2.4 *Emissions of hydrocarbons*

Figure 7.3 depicts the non-methanic hydrocarbon (HC) emissions estimated for diesel fuels. These are shown as emissions on an energy basis, as emissions on a per tonne-km basis for trucks, and on a per passenger-km basis for buses using the same energy intensities previously noted.

HC emissions of diesohol are comparable with those of LSD.

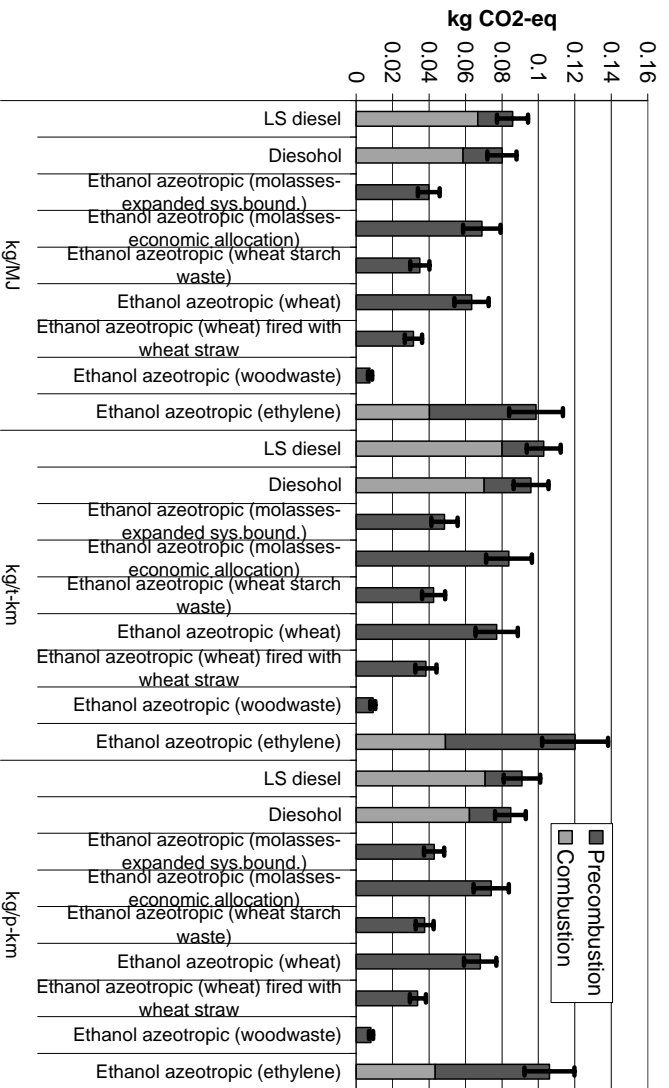


Figure 7.1 Exposed emissions of greenhouse gases for diesohol and ethanol made from various sources.

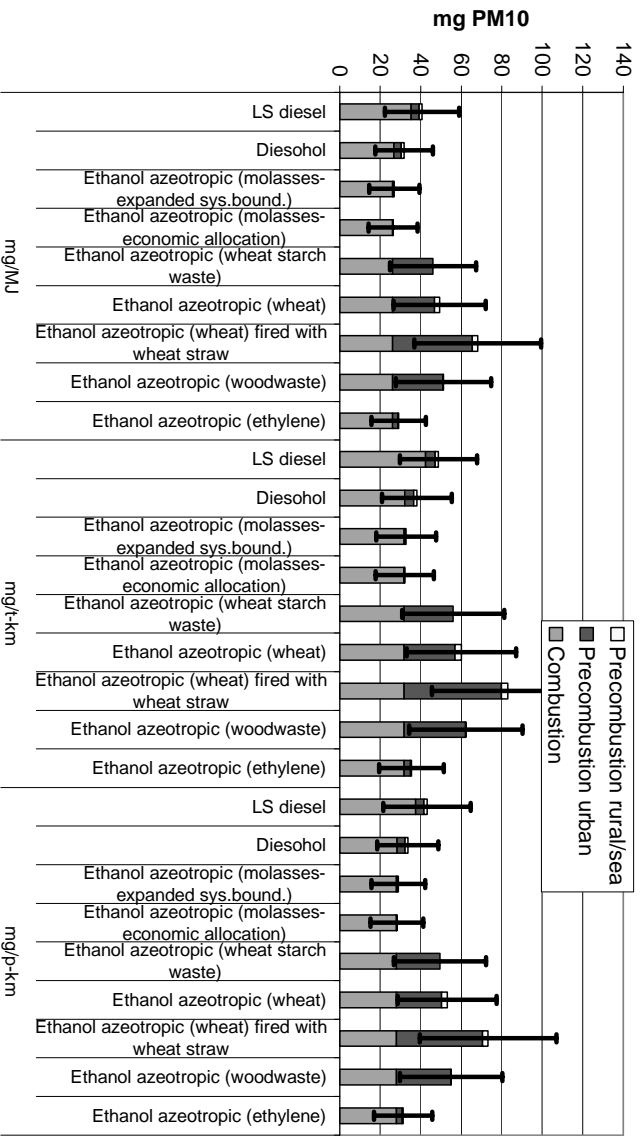


Figure 7.2 Exposed emissions of particulate matter for diesohol and ethanol made from various sources.

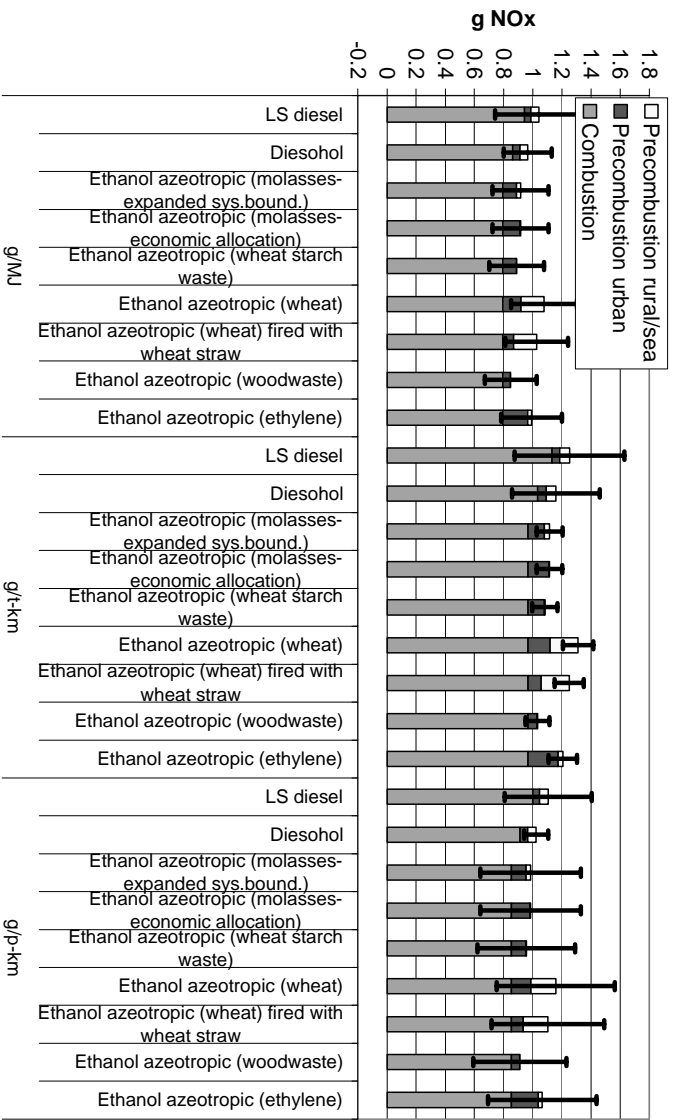


Figure 7.3 Exposed emissions of oxides of nitrogen for diesohol and ethanol made from various sources.

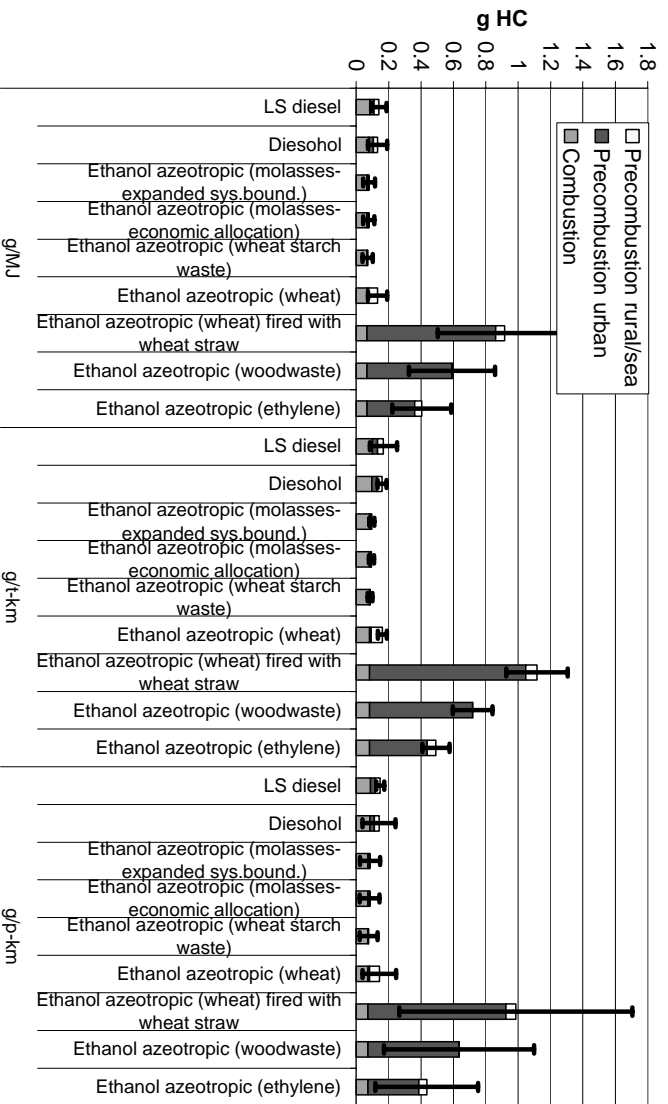


Figure 7.4 Exposed emissions of hydrocarbons for diesohol and ethanol made from various sources.

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### 7.3 *Viability and Functionality*

Problems may occur with the fuel injection equipment, and with the formation of vapour locks. Both can be easily remedied. Diesohol has passed stability test conducted by Shell. To date diesohol has been a niche fuel and thus the situation with respect to availability and warranty has not been clarified. During testing of buses using diesohol, the fuel was blended by delivering diesel to Manildra, near Nowra, and blending the diesel with ethanol and emulsifier.

### 7.4 *Health and OH&S*

As the composition of diesohol is 85% diesel the production and transport emissions associated with diesohol production are assumed to be similar to LSD. The LCA indicates that urban precombustion PM10 emissions of diesohol (39 mg/km or 3.63 mg/MJ) are marginally lower than LSD (43 mg/km or 4.0 mg/MJ), though the urban precombustion HC emissions are similar at 0.29 g/km or 0.026 g/MJ.

The LCA indicates that combustion PM emissions from diesohol (289 mg/km or 26.8 mg/MJ) are lower than LSD (380 mg/km or 35.3 g/MJ).

There is limited information available on air toxic emissions for diesohol. The high proportion of diesel in diesohol suggests that the air toxic emissions are unlikely to be substantially different to LSD, though tailpipe emissions of acrolein from diesohol appear to be lower than from diesel. The LCA indicates that HC combustion emissions of diesohol are similar to LSD.

The flash point and flammability characteristics of diesohol are those of alcohol. This requires that diesohol be considered and handled as gasoline (petrol) rather than as diesel fuel, even though the flash point of petrol is considerably lower than that of ethanol (13°C). In practical terms, APACE Research handles the fuel as it would ethanol to ensure safety.

### 7.5 *Environmental issues*

#### *ESD issues*

The environmental impact from the production of diesohol are the same as those from the production of the diesohol feedstocks; namely diesel and ethanol.

In particular, we draw attention to the fact that appropriate disposal of the refinery waste-products is crucial to environmental impacts or benefits. Dunder application is often criticised as being the cause of poor waste quality in Queensland, though there is little evidence of this ([www.sunfish.org.au/fishkills/fishkills.htm](http://www.sunfish.org.au/fishkills/fishkills.htm)). Conversely, appropriate and careful disposal of dunder means that many farmers in the district near Sarina now use it as a fertiliser and soil conditioner - even though it was once considered a poison.

#### *Sustainability*

Ethanol from sugar or wheat is liable to be a niche fuel and thus there are no sustainability issues associated with it. Large-scale usage of ethanol will require ligno-cellulosic production to be economical.

Foran and Mardon (1999) contains details of ethanol and methanol production technology and supply constraints, and of the environmental consequences of both crop and fuel production processes. They claim that if ligno-cellulosic ethanol production is used then it would be possible to establish biomass plantations over the next 50 years that meet 90% of Australia's oil requirements, and specifically to supply all transportation fuels. To do this using ethanol requires biomass production to cover up to 19 million hectares of Australia's croplands and high rainfall pasture zones. Their modelling approach envisages substantial environmental benefit. In addition to the reduction in greenhouse gas emissions (up to 300 million tonnes by

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the year 2050), the large-scale planting of tree and shrub crops as ethanol feedstock would help to control dryland salinity and associated problems.

### *Groundwater*

We are not aware of any issues related to groundwater contamination.

## **7.6 ADR Compliance**

Diesohol can be expected to meet all future Australian Design Rules for all pollutants except total hydrocarbon which may be slightly above Euro3 and Euro4 standards. APACE Research advises that vapour lock problems led to higher HC and CO emissions as reflected in Arcoumanis (2000). APACE has indicated that the addition of a booster pump now overcomes vapour lock and the resulting HC and CO problem which means that low sulfur diesohol should be able to meet all future ADRs.

## **7.7 Summary**

### *7.7.1 Advantages*

- Since it contains a renewable fuel component it produces less fossil CO<sub>2</sub> than conventional fuels.
- Particulate emissions are lowered.
- 1,3 butadiene and benzene levels decrease as the ethanol concentration increases.
- Less sulfur.

### *7.7.2 Disadvantages*

- Overseas, the chemical emulsifiers used to blend ethanol and diesel contain harmful chemicals. According to APACE the chemical emulsifier that they use is composed only of hydrocarbons and oxygen and is thus no more harmful than diesel fuel.

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