THE INTRODUCTION OF UNLEADED PETROL INTO AUSTRALIA

Ian McFarlane
Shell Company of Australia Limited

Michael Cass
Shell Company of Australia Limited

ABSTRACT:

The paper examines the reasons that led to the introduction of unleaded petrol and outlines the implications for those involved. Unleaded petrol, which will be available at a significant number of service stations across Australia by 1 July 1985, will grow in demand as new dedicated unleaded vehicles replace the existing vehicles, most of which will still require leaded super. The total system will therefore take more than a decade to become completely unleaded.

The production of unleaded petrol requires an increase in hydrocarbon quality, the size and cost of which will vary from refinery to refinery and will be incurred over a number of years.

The sensitivity of the catalyst emission control system to trace amounts of lead is such that additional segregation procedures are required throughout the distribution system.

Planning within the oil industry has been going on for many months and a generally smooth introduction is expected.

INTRODUCTION

Beginning in the second quarter of 1985, unleaded petrol will appear at retail service stations throughout Australia. Its appearance will be part of a package encompassing motor vehicles and the emissions they are permitted to release and will be the culmination of many years of analysis, debate and decision making. From the petroleum industry's point of view, the introduction of unleaded petrol will be the most significant marketing change since the re-introduction of super grade petrol in 1955.

This paper examines the reasons that led to the decision to introduce unleaded petrol by considering each of the major protagonists - governments, the automotive industry, the petroleum industry and consumers.

GOVERNMENTS' REGULATION OF AUTOMOTIVE POLLUTION

In the late '70s, concerns were expressed about increasing ozone levels in Sydney and Melbourne. Figure 1 shows the number of days exceeding the National Health and Medical Research Council standard for ozone in Melbourne and Sydney. An increase in the mid '70s is apparent in Sydney. However, there is insufficient data for Melbourne to establish a trend. The formation of ozone (photochemical smog) in the atmosphere is the result of complicated chemical reactions involving hydrocarbons, oxides of nitrogen and radiation (sunlight). Hydrocarbons and nitrogen oxides are both present in automotive exhaust gases, and control of these emissions represented one option for reducing ozone formation. Controls on stationary sources were also planned.

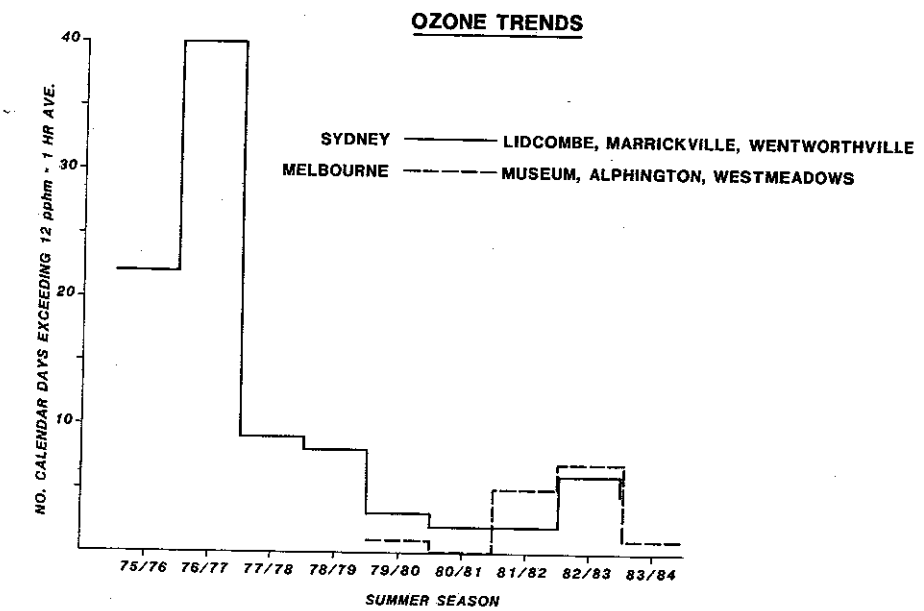

Figure 1 - Number of days on which the historical ozone monitoring networks of Sydney and Melbourne exceeded 12 pphm (one-hour maximum). All recordings to nearest pphm.

INTRODUCTION OF UNLEADED PETROL

In July 1979, the Australian Transport Advisory Council (ATAC), comprising Transport Ministers from Territory, State and Federal Governments, requested its Committee on Motor Vehicle Emissions (COMVE) to report on the development of a long term national vehicle emissions strategy. COMVE reported in February 1981, and based on this advice ATAC resolved that

- new cars and derivatives such as station wagons and panel vans manufactured after 1 Jan. 1986 be designed to operate on unleaded petrol and to meet the equivalent of USA 1975 emission standards.

- unleaded 91.5 octane petrol be available at a significant number of retail outlets from 1 July 1985.

Subsequent ATAC resolutions require vehicles other than passenger cars and derivatives to be designed to operate on unleaded petrol from 1988, although NSW has decided that all petrol engined vehicles manufactured after 1 Jan. 1986 must be designed to operate on unleaded petrol. Table 1 shows the time table for new vehicles to use unleaded petrol. Emissions standards for motor vehicles are implemented through the Australian Design Rule (ADR) system, and ADR37 covers emissions control of passenger cars and derivatives.

Both the automobile industry and the petroleum industry have accepted the decisions of the various governments and have agreed to make the required vehicles and petrol available, according to the proposed timetable.

TABLE 1

TIME TABLE FOR NEW VEHICLES TO USE UNLEADED PETROL

CLASS OF VEHICLE	AUSTRALIA EXCEPT NSW	NSW
Passenger cars & derivatives	Jan 86	Jan 86
Forward control passenger vehicles	Jan 88	Jan 86
Light commercial vehicles	Jul 88	Jan 86
Motor cycles	Mar 88	Jan 86
Other	Jul 88	Jan 86

Figure 1 also shows that the increasing number of days exceeding the ozone standard at the three long running sites in Sydney has not continued beyond 1976/77. The reasons for this sudden reduction have not been identified, although part of the subsequent reduction is no doubt due to the effects of earlier controls on both vehicles and stationary sources. Emphasis in publications has tended to shift away from ozone (and the precursor hydrocarbons) to lead emissions as justification for the move to unleaded petrol.

AUTOMOTIVE INDUSTRY

The existing standards for car exhaust emissions and those to be met under ADR37 are shown in Table 2. The ADR37 rates for hydrocarbons and carbon monoxide represent approximately 75% reductions compared with uncontrolled vehicles, and the nitrogen oxide rate a 20% reduction. To meet these new emissions standards, it is likely that most cars will incorporate catalytic converters in their exhaust systems. Converters have been used on vehicles sold in the USA for about a decade and are intended to maintain emission levels for at least 80,000 km with minimum maintenance.

In addition to meeting more stringent exhaust emission standards for cars manufactured from 1986, the car companies will have to meet a lower evaporative emission standard and modify petrol fillers to accomodate the new narrower nozzles to be fitted to unleaded petrol dispensing pumps. These requirements will add to the cost of a new car, probably of the order of several hundred dollars for each vehicle. The major part of the cost increase is likely to be the catalytic converter which contains noble metals including platinum. Car manufacturers remain committed to reducing fuel consumption in new cars, and the move to unleaded petrol and generally lower compression ratios will make this more difficult to achieve. However, the replacement of some engine-mounted emissions control devices by a catalytic converter may allow engines to be optimised for better fuel consumption.

TABLE 2

PASSENGER CAR MAXIMUM EMISSIONS STANDARDS - AUSTRALIA

	ADR27A	ADR37
Hydrocarbons (g/km)	2.1	0.93
Carbon monoxide (g/km)	24.2	9.3
Nitrogen oxides (g/km)	1.9	1.93
Evaporative hydrocarbons (g/SHED test)	6	2

PETROLEUM INDUSTRY

The petroleum industry was represented on COMVE, and participated in the deliberations that resulted in the decision to introduce unleaded petrol. The industry remains unconvinced that the program is justified on health or other grounds, but nevertheless will provide the required unleaded petrol in accordance with the ATAC resolutions. An Australian standard for unleaded petrol has been published, and Table 3 contains the more significant properties which are compared with those of regular (standard) and super grades.

Policy

The regular grade of petrol will be replaced by the new unleaded petrol throughout Australia, and facilities currently used for regular will be converted to unleaded petrol duty. The two grade manufacturing/distribution/marketing system that has been developed over the last 30 years will therefore be maintained. Regular petrol buyers will have to switch to unleaded petrol or to super petrol.

TABLE 3

PROPERTIES OF PETROLS - AUSTRALIA

	Regular	Super	Unleaded
Research octane number	89/92	97	91-93
Motor octane number	Not stated		82 min
Lead content	Varies between states		13mg/L max.
Phosphorus content	Not stated		1.3 mg/L max.
Sulphur content	Not stated		0.1 % max.

As new vehicles requiring unleaded petrol enter the fleet and increase in market share, super petrol facilities will gradually be converted until the whole system is unleaded. This process is expected to take more than a decade, and leaded super petrol may still be marketed in the next century.

Refineries

All 8 Australian refineries produce both grades of petrol and this will be the case when unleaded petrol is introduced. However, the ease with which unleaded petrol is able to be produced will vary considerably between refineries depending on crude diet, plant configuration/capability and allowable lead levels in the leaded grade. Most refineries will need to spend capital on new plant to provide for the increased hydrocarbon quality required. Figure 2 indicates the quality changes that will be necessary. While the average quality increase in the petrol pool is 3 octane numbers, some refineries will not have to provide a significant quality increase, while for others the increase is 6 octane numbers.

Some capital has already been invested, and more will be spent as unleaded petrol increases market penetration.

Distribution System

Figure 3 is an outline of the distribution system that moves petrol from refineries to the purchaser at a retail service station. The system is characterised by the long distances that can be traversed, and by the number of modal changes that can be involved in providing petroleum products to more remote locations. The two existing grades of petrol have been successfully delivered through this system for many years, indicating an inherent capability of providing adequate grade segregation. With unleaded petrol, the requirement that it reach the retail customer with less than 13 mg Pb/L while still interfacing with leaded super petrol containing from 300 to 840 mg Pb/L places a greater burden on the system. Some capital expenditure will be required to ensure adequate segregation initially, and further expenditure will be needed as super petrol facilities are gradually converted to unleaded.

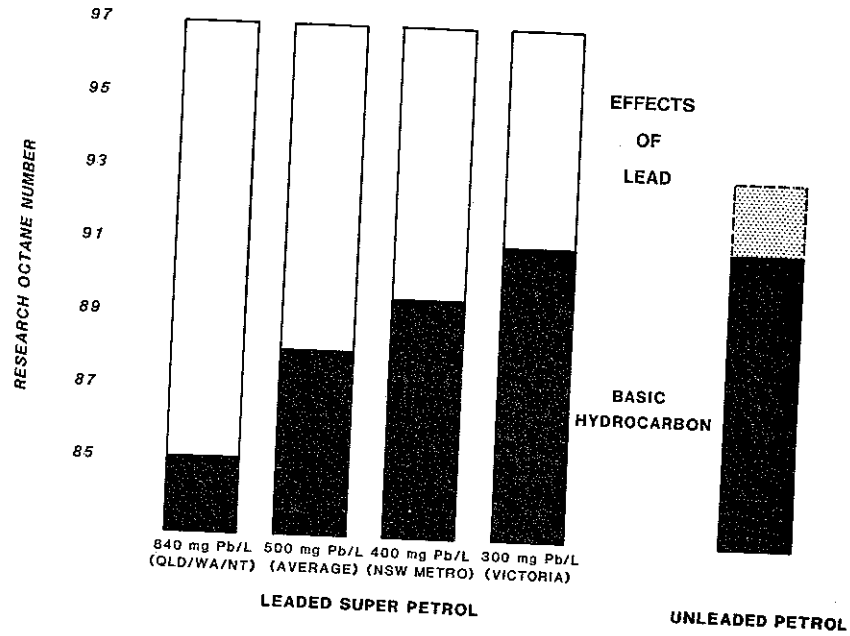

Figure 2 - Effects of lead alkyls on petrol - Australia

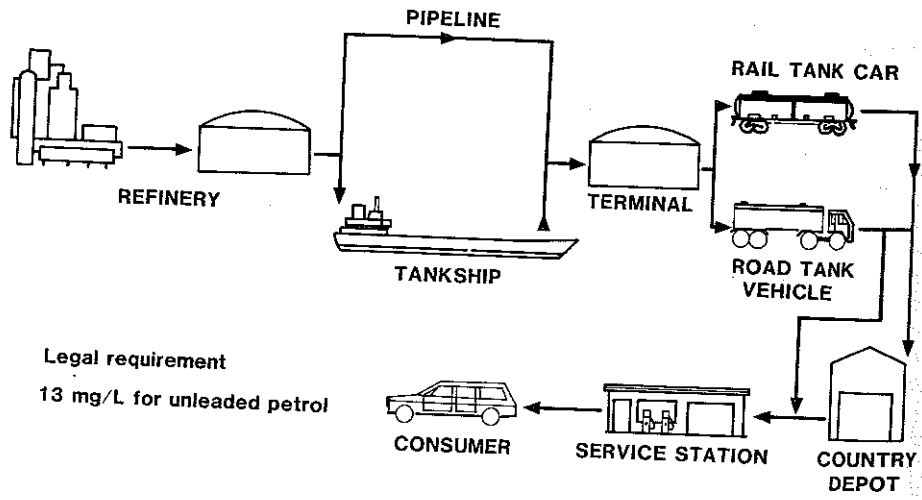

Figure 3 - Distribution System for Petrol

INTRODUCTION OF UNLEADED PETROL

Retail Outlets

The industry has agreed that unleaded petrol will be available at a significant number of sites nationally from 1 July 1985. N.S.W. requires all sites to offer unleaded by that date and Victoria essentially all sites. It is not possible to generalise about how retail outlets will achieve this because they vary as to throughput, ownership, age, remoteness, storage capability and economic viability.

Outlets handling the bulk of petrol sales will be able to offer unleaded petrol by converting the regular tank/pump(s). Some expenditure will be necessary on isolating the tank from the leaded system, on decoration of the pump, and on new narrow nozzles. This is in hand, and customers can expect to see unleaded petrol pumps in the second quarter of 1985.

Some retail sites do not have the capability of storing/dispensing more than one grade of petrol, and these are frequently in remoter locations serving local communities and the occasional traveller. Since these sites often have small throughputs, there is unlikely to be an economic justification for installing a second tank and/or pump to handle unleaded petrol. It is to be hoped that the authorities allow such sites to continue selling super petrol until the market determines that a changeover should be made to unleaded petrol, thereby maintaining a local amenity in many remote locations.

Other Outlets

While most petrol is sold through retail outlets, there are other important customers who must be considered. The 200L drum is a common sight in country areas, and it will be necessary to provide drums of unleaded petrol in certain circumstances. Quality control will be a major consideration because most drums are reused many times over their lives. Petrol is also supplied in bulk to many customers other than retailers. Many farmers, manufacturing and commercial companies have bulk storage for petrol, and this is usually limited to one grade. There are no legal requirements for such customers to store unleaded petrol, although sooner-or-later all will do so. However, the legal requirement for fueling new unleaded vehicles only with unleaded petrol will result in a demand for two grades of petrol in many cases, and arrangements will need to be made to achieve this.

CONSUMERS

At the present time, engines for petrol vehicles can be designed for either regular or super petrol at the designer's option. In Australia, most have chosen to design for other than standard at 89 octane, probably for several reasons including efficiency/fuel consumption reasons. Owners of vehicles have been prepared to pay a premium of 1 - 2 c/L for the super grade of petrol, presumably for real or perceived benefits in performance, with the result that super comprises around 95% of retail sales.

New Vehicles

The introduction of unleaded petrol, and the accompanying emissions controls and other requirements mean that some degree of freedom for both engine designer and consumer will be lost. The engine design will need to ensure that the unleaded petrol engine performs without abnormal knock on 91 RON petrol, and the consumer will be required to use that fuel. However, some choice remains to the consumer in that there are fuels other than petrol, and the new vehicle buyer will be able to consider diesel or LPG should unleaded petrol not suit particular requirements.

Obviously, the new vehicle buyer will be paying for the additional costs of the unleaded petrol/stricter emissions requirements. This will be an up-front charge in the cost of the vehicle, although some organisations state that this charge will be offset (partially or completely) by reduced maintenance costs and lower fuel consumption over the vehicle life.

Existing Vehicles

Leaded super petrol will be marketed for many years to cater for those vehicles that require it for mechanical reasons. Some users of leaded regular will change to the super grade when regular ceases to be marketed. Some regular users may switch to unleaded petrol, the decision being influenced by mechanical/octane satisfaction factors as well as the price relativity between unleaded and leaded super grades. It is expected that vehicle manufacturers will provide information soon on which makes and models can use unleaded petrol.

Other Petrol Users

The unleaded petrol programme covers only petrol engined vehicles. There exists a multitude of other petrol engines including small generators, outboard motors, lawn mowers etc. In aggregate, these uses represent a minute part of total-petrol demand, but nevertheless decisions will need to be made about the type of petrol to be used both in existing engines and in new engines sold after unleaded petrol becomes available. Usually, the engine manufacturers' guidance should be sought.

CONCLUSIONS

Australia is not alone among nations in determining that more stringent vehicle emissions standards should be introduced. However, in requiring the use of unleaded petrol for all new vehicles, the Australian approach has been different. There are signs that the European Economic Community is likely to do the same from the early 90s, although for somewhat different reasons.

As with many environmental matters, the Australian emissions/unleaded petrol decision was difficult. There were many variables to be considered, most of them such as vehicles and air quality had long lead times, costs and benefits were difficult to quantify and there was more than the usual number of uncertainties about human health effects. Ultimately, the decision was taken by the politicians acting on broadly-based advice from public servants, the motor and petroleum industries and consumer representatives. The costs of the programme are usually stated in relatively palatable units such as $250/vehicle and less than one cent/L for petrol. However, these represent about $100 million/y for vehicles and about $15 million/year for each 0.1 c/L petrol cost increase, which are not inconsiderable additions to the economy's cost structure.

No doubt there will be some minor problems with the programme, but these are unlikely to be very significant in the long term which will see the present vehicle fleet replaced by new vehicles requiring unleaded petrol.