REVIEW OF FUEL QUALITY REPORT

STAKEHOLDER CONSULTATION and SCENARIO DEVELOPMENT

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SUMMARY OF ABBREVIATIONS

ADR	Australian Design Rule
AIP	Australian Institute of Petroleum
CNG	Compressed natural gas
EA	Environment Australia
EU	European Union
FCAI	Federal Chamber of Automotive Industries
FORS	Federal Office of Road Safety
GDI	Gasoline Direct Injection
GHG	Greenhouse gas
LCV	Light Commercial Vehicle
LPG	Liquified petroleum gas
MMT	Methylcyclopentadienyl manganese tricarbonyl
MTBE	Methyl tertiary butyl ether
MVEC	Motor Vehicle Environment Council
NAFC	National Average Fuel Consumption
NEPC	National Environment Protection Council
NEPM	National Environment Protection Measure
NRTC	National Road Transport Commission
OBD	On board diagnostics
PAH	Polycyclic aromatic hydrocarbons
$PM_{2.5}$	Particulate matter of less than 2.5μm diameter
PM_{10}	Particulate matter of less than 10μm diameter
PULP	Premium unleaded petrol
RON	Research Octane Number
RVP	Reid vapour pressure
ULP	Unleaded petrol
ULSD	Ultra low sulphur diesel
UNECE	United Nations Economic Commission for Europe
VKT	Vehicle kilometres travelled

PART 1: STAKEHOLDER CONSULTATION

1 INTRODUCTION AND BACKGROUND

Coffey Geosciences Pty Ltd have been commissioned by Environment Australia to undertake a Review of Fuel Quality Requirements for Australian Transport. The objectives of this review include an assessment of the impact of changes to fuel specifications on Australian refineries, vehicle manufacturers and consumers. In order to achieve this objective, the development of scenarios for fuel quality has included extensive consultation with stakeholders, and detailed consultation with the major stakeholders in the oil and motor vehicle industry.

Part 1 of this paper summarises the stakeholder consultation undertaken by the Coffey project team, including an outline of the issues discussed with the stakeholders and a discussion of the issues raised by the stakeholders. Part 2 of this paper describes the background to the scenario development process, and the rationale behind the development of the six scenarios for fuel quality. The scenarios developed are then outlined in detail.

2 CALL FOR COMMENTS

The stakeholder consultation process commenced with the circulation of a letter to the stakeholders, introducing Coffey and outlining the objectives of the study. The letter informed the stakeholders that a series of scenarios were to be developed to represent the range of likely changes in fuel quality over the next ten years. Comment was sought from the stakeholders regarding the key issues to be considered in the fuel quality scenarios. A copy of the letter sent to the stakeholders is included in Appendix A.

The stakeholders included in the consultation process are listed in Appendix B. This list was based on that provided in the tender specification by Environment Australia.

2.1 Summary Of Responses

Written responses were received from 29 stakeholders. The key issues nominated by these stakeholders are summarised in Appendix C. Many of the stakeholders provided more detailed written responses, which are included in Attachment 1. Many of the stakeholders who did not provide written responses attended meeting with representatives of the project team. The meetings held with the stakeholders are discussed in Section 3.

3 SCHEDULE OF MEETINGS WITH STAKEHOLDERS

Meetings with Key Stakeholders were arranged and held as indicated in Table 1.

Table 1: Schedule of Meetings with Stakeholders

Organisation	Date	Location
Department of Industry, Science And Resources	29 March	Sydney
Federal Chamber Of Automotive Industries	30 March	Sydney
NSW Environment Protection Agency	31 March	Bankstown, NSW
Australian Automobile Association and NRMA Ltd	9 April	Canberra
Australian Trucking Association	9 April	Turner, ACT
Commonwealth Government Agencies	14 April	Canberra
BMW Australia Pty Ltd	15 April	Melbourne
Ford Motor Co of Australia Ltd	15 April	Melbourne
Nissan Motor Co (Australia) Pty Ltd	15 April	Melbourne
National Road Transport Commission	15 April	Melbourne
Society of Automotive Engineers – Australasia	15 April	Melbourne
Holden Ltd	16 April	Port Melbourne
Toyota Australia	16 April	Port Melbourne
Mitsubishi Motors Australia Ltd	20 April	Clovelly Park, SA
NEPC Service Corporation	20 April	Adelaide
SA Government Agencies	20 April	Adelaide
Gull Petroleum	20 April	Perth
Caterpillar of Australia Ltd	21 April	Tullarmarine, Vic
Victorian Government Agencies	21 April	Melbourne
NSW Government Agencies	22 April	Sydney
Iain Cameron Consultancy	30 April	Perth
Queensland Government Agencies	7 May	Brisbane
Mobil Oil Australia Ltd	25 May	Melbourne
Liberty Oil Pty Ltd	25 May	Melbourne
BP Australia Ltd	7 May 24 May 26 May	Sydney Sydney Sydney
Caltex Australia Ltd	24 May	Sydney
Shell Company of Australia Ltd	26 May	Sydney
Australian Institute of Petroleum	25 Feb 26 May	Melbourne Sydney
Ethyl Corporation	23 June	North Sydney

4 ISSUES DISCUSSED WITH STAKEHOLDERS

Suggested issues for discussion were circulated to Stakeholders prior to each meeting. These were provided to prompt (rather than constrain) discussion. The suggested issues were generally as follows –

Objectives of the meetings

- To identify issues that may impact on fuel quality requirements over the period to 2010 (with a look to 2020).
- To identify the range of scenarios which should be considered for evaluation.

Policy Settings/Issues

- Air Quality and NEPC Ambient Air National Environment Protection Measure (NEPM)
- Greenhouse commitments
- Emission standards harmonisation
- Reduction in National Average Fuel Consumption (NAFC) for passenger cars, 4WDs and light commercial vehicles (LCVs)
- Phase out of leaded petrol
- Petrol research octane number (RON)
- Industry Policy
- Other Policy Issues

Technical Issues

- Euro emission standards and technologies
- Fuel quality requirements

Baseline and Scenarios for Evaluation

- Emission standards/NAFC
- Fuel specifications

Brief notes of each meeting were made and circulated to the Stakeholder for agreement or amendment as appropriate. The final agreed notes are presented as Attachment 2 to this report.

5 DISCUSSION OF ISSUES RAISED BY STAKEHOLDERS

5.1 Objectives Of The Meetings

All Stakeholders considered the Review to be important, and were keen to provide their individual views and perspectives. All discussions were frank and far ranging, but did not necessarily cover all the suggested issues or follow the suggested order. Discussion was focused on those issues of most concern to each Stakeholder.

5.2 Policy Settings/Issues

5.2.1 Air Quality and NEPC Ambient Air NEPM

All State and Commonwealth Agencies indicated strong Government commitment to achieving and maintaining compliance with the ambient air quality standards specified in the NEPM. The major non-compliant pollutants are particles (PM_{10}), PC smog (ozone) and to a lesser extent NO_2. Motor vehicles are a major source of these pollutants (or their precursors) in all jurisdictions.

Diesel exhaust particulate is especially a concern. In Australia, PM_{10} typically contains a high proportion of particles in the $PM_{2.5}$ fraction, which is the main health and environmental concern. Diesel particulate comprises 80 to 90% $PM_{2.5}$ and contains some toxic and carcinogenic compounds.

The agencies identified reduction of petrol Reid Vapour Pressure (RVP) as a cost-effective means of controlling vehicle evaporative hydrocarbons. NSW has negotiated a Memorandum of Understanding with the Petroleum Industry for phased reductions in RVP to 67 kPa (pool average) for summer 1999/2000 and 62 kPa for summer 2000/2001. The petroleum industry indicated satisfaction with the process of negotiation, and the result. Other State agencies are pursuing similar negotiations with the industry.

Concerns were expressed that projected growth in vehicle kilometres travelled (VKT) will erode the benefits of vehicle emission standards introduced to date, and this (along with emissions from non-vehicle sources) will lead to increasing non-compliance with the NEPM. More stringent new vehicle emission standards are viewed as an essential strategy to combat future growth. Most Government agencies support introduction of Euro 2 and/or Euro 3 standards for air pollution control reasons. Some advocated introduction of Euro 4 emission standards, especially for diesel vehicles.

The Automobile Associations and the Australian Trucking Association strongly supported early introduction of Euro 2, 3 and 4 emission standards, more as a means to force adoption of latest technologies than for air quality reasons.

Other stakeholders were less strong in their views, considering Australia does not have a significant air pollution problem and that introduction of Euro 3 and 4 emission standards may not be justified in the 5 to 10 year term.

The Federal Chamber of Automotive Industries (FCAI) considers Euro 3 standards should only be considered for introduction in Australia once the resulting air quality benefits of Euro 2 implementation have been studied (ie, in the latter part of the next decade). Stakeholders in the motor industry expressed the view that inspection/maintenance programs (as are being introduced in NSW and are under consideration in other States) should be given priority over introduction of more stringent vehicle emission standards.

The Australian Institute of Petroleum (AIP) considers that while local fuel quality hikes in-line with overseas trends are inevitable, a lag of at least 2 to 3 years is appropriate as Australian pollution problems are much less than in Europe, USA or Asia.

5.2.2 Greenhouse Commitments

Commonwealth and State agencies indicated a strong commitment by all Governments to meet the greenhouse gas (GHG) emissions targets set in the Kyoto Protocol, and that this may well become a main driving force in transport policy.

- Transport contribution to total GHG emissions is about 12%, and this proportion is growing.
- VKT is growing at about 1.5%/year.
- The Australian Greenhouse Office has estimated that energy use in transport will increase by 35% from 1990 levels by 2008, against Australia's overall GHG commitment of only 8% increase.

All agencies consider substantial improvement in vehicle fuel efficiency is therefore most important, and that adoption of world's best technologies is one strategy that should be pursued. The agencies identified other strategies that Governments must consider –

- vehicle fuel consumption standards and incentives.
- incentives for accelerated adoption of new engine technologies (such as petrol/diesel-electric hybrids, and fuel cells).
- incentives for 'clean' petrol and diesel.
- incentives for less GH-intensive fuels (such as compressed natural gas (CNG), liquified petroleum gas (LPG) and methanol), and renewable fuels (such as ethanol).
- encouragement for use of public transport.

The FCAI believe that high octane fuel (98 RON) is essential to optimise fuel consumption, in conjuction with meeting the stringent emission standards called for in the Euro 4 specifications.

5.2.3 Emission Standards Harmonisation

Commonwealth agencies and the National Toad Transport Commission (NRTC) indicated the Government's total commitment to harmonisation of vehicle emission standards with International Standards (ie those of the United Nations Economic Commission for Europe (UNECE), which are technically equivalent to standards adopted in the European Union - ie the 'Euro' Standards). The Commonwealth Government's *'Environmental Strategy for the Motor Vehicle Industry'* indicates intent to achieve 'full' harmonisation by 2006.

- The Commonwealth has indicated this commitment within the World Trade Organisation, the Asia-Pacific Economic Cooperation forum, and in the Trans Tasman Mutual Recognition Agreement.
- The Commonwealth intends to sign the 'Treaty 58' agreement during 1999.
- Japan signed the 'Treaty 58' agreement in late 1998.

- Japan/MITI has agreed to adopt Euro 3 for diesels in 2003/4, and has proposed Euro 4 as a global standard for cars.
- The US has a project to assess harmonisation with UNECE standards.
- There is increasing focus around the world on the UNECE standards as future 'world' standards.

Most stakeholders consider harmonisation is inevitable. There are though, considerable differences in view as to what 'full' harmonisation might mean.

- DOTC/FORS consider harmonisation with UNECE technical procedures is achievable, but that harmonisation of standards on schedule with the European Union is unrealistic. This view is shared by most stakeholders in government and industry.
- Some state agencies (particularly in NSW) and the Automobile Associations consider full harmonisation on schedule with the EU is achievable and desirable as this will force adoption of world's best vehicle technologies.
- NRTC and NEPC/SC indicated MVEC's view was that harmonisation to Euro 3 for both petrol and diesel vehicles, should be accomplished as soon as practicable. MVEC had not yet considered Euro 4.
- Many stakeholders pointed out that introduction of Euro 2, 3 and 4 vehicle emission standards in Europe is underpinned by concurrent quality standards for market fuels, upon which continuing compliance with the emission standards is dependent.
- The FCAI supports harmonisation to Euro 2 levels only, with consideration of Euro 3 at a later date. The FCAI considers availability of fuel to the equivalent Euro standards to be a prerequisite for introduction of any Euro emission standard in Australia.
- Vehicle importers, while supporting the FCAI's position, are more comfortable with harmonisation on a schedule following the EU more closely. Some imported Euro 2-technology (petrol and diesel) vehicles, and a few Euro 3-technology vehicles are already in the Australian market. (Some US-sourced heavy diesel vehicles have engines with US 1998/9 certification, which is equivalent to Euro 2+ standards.) It is probable that Euro 3-technology vehicles (both petrol and diesel) will not achieve designed emission levels, fuel efficiency or performance durability on current quality, Australian market fuels.
- The Australian motor manufacturers have some difficulty with introduction of Euro 3 standards for cars with locally manufactured engines. These difficulties would be significantly reduced if introduction could be synchronized with model change cycles (approximately 2006/7). Too early an introduction date for Euro 3 standards would have significant implications for local engine manufacture.
- The Society of Engineers considers that delaying implementation of Euro 3 emission standards to 2006, would allow time for advanced engine and emission control technologies to mature, and would likely produce a better result. This would be especially so for local manufacturers, who would be able to transfer corporate technology at lower cost.

- Overall, the automotive industry considers Australian fuel quality (as opposed to vehicle emission standards) should be harmonised with Euro fuel quality, as soon as practicable. This would –
    - support adoption of developing engine/emission control technologies in a commercially competitive time frame.
    - allow cost-effective reductions in emissions and fuel consumption.

  Sulphur in both diesel and petrol, and RON/MON in petrol, are the important parameters.

  The motor industry considers urban air quality in Australia is improving, and that introduction of vehicle emission standards beyond Euro 2, is not justified.
- The petroleum refiners accept the need to supply fuel of a quality that will support future vehicle technologies. They question the need for fuel quality standards to be as stringent as mandated in Europe. The refiners expressed very strong concerns that the high level of investments required in Australian refineries to produce Euro 4 grade fuels (especially), would not be recoverable in the market in competition with overseas suppliers. Adoption of such stringent fuel quality standards may add pressures for refinery restructuring, and may lead to closures.
- The automotive industry, the petroleum industry, and the automobile associations indicated a strong view that future fuel quality standards (whatever may be agreed) should be mandated and enforced. This view was also put by some government agencies, which indicated there had already been some discussion of a possible fuel quality NEPM, possibly to be implemented through an agreement (MOU) with the petroleum industry.

5.2.4 Reduction in NAFC for passenger cars, 4WDs and LCVs

Commonwealth agencies indicated strong Government commitment to achieving a 15% reduction in National Average Fuel Consumption (NAFC) for new cars, over 'business as usual' by 2010 (as stated in the *'Environmental Strategy for the Motor vehicle Industry'*). The Commonwealth will negotiate a new NAFC agreement with the motor industry during 2000, and will seek to have 4WDs and LCVs included.

The Commonwealth agencies regard 'business as usual' to be a reduction in NAFC of 1% per year from 2000 to 2010 (building on the previous NAFC agreement which is equivalent to a 10% reduction from 1990 levels, to 8.2 L/100kms for calendar year 2000). A further reduction of 15%, implies the Government will seek a total reduction in NAFC of 23½ % by 2010, to 6.3 L/100kms (over the current Australian Standard test procedure).

State government agencies, and the Automobile Associations indicated support for adoption of these targets, and consider –

- they are achievable given rapidly developing technologies, and the European industry's commitment to achieve 25% reduction in a similar time period.
- they are necessary in the context of achievement of Australia's overall greenhouse gas reduction commitments under the Kyoto Protocol.

The motor vehicle industry indicated that while it does not necessarily accept these targets are achievable, it is keen to negotiate a NAFC agreement that would be practicable, though challenging. Concerns were expressed that stringent fuel consumption targets would severely disadvantage locally manufactured vehicles.

Whatever agreement is reached on future NAFC targets, the motor vehicle industry considers availability of low (500 ppm) (or ultra low (50 ppm)) sulphur, 98 RON petrol is essential to achieve the lower fuel consumption potential of new, and developing technologies. The industry cites 30 ppm sulphur (as indicated in its *'World-Wide Fuel Charter'*) as the maximum desirable for performance durability of advanced engine/emission control systems, in the long term.

5.2.5 Phase-out of Leaded Petrol

The Commonwealth Government's commitment to early phase-out of leaded petrol is stated in its *'Environmental Strategy for the Motor vehicle Industry'.*

There was no suggestion among stakeholders that this was a significant policy issue.

The petroleum industry and other stakeholders considered early phase-out is appropriate given that suitable lead replacement additives are available. Also, early phase-out would enable terminal and service station storage tanks to be converted to support increasing volumes of 95 Research Octane Number (RON) ULP.

5.2.6 Petrol RON

Most stakeholders felt that introduction of Euro standards would inevitably result in increasing demand for 95 RON ULP (PULP) for new vehicles. This would be consistent with the Commonwealth's *'Environmental Strategy for the Motor vehicle Industry'*.

- Government agencies in particular were concerned that this would put pressure on refiners to increase benzene, aromatics and olefins in order to achieve higher pool octane. On the other hand, the refiners were concerned that limits on these compounds would substantially increase the investment required to make higher-octane petrol.
- Some stakeholders, including government agencies, indicated concerns that there may be demand for use of MTBE and/or other octane enhancement additives that would have uncertain environmental effects. The refiners indicated they would seek to open debate on the environmental effects of MTBE (methyl tertiary butyl ether) and MMT (methylcyclopentadienyl manganese tricarbonyl), and through the scenario modelling process, would conduct some analyses on the refinery costs/benefits at each refinery where their use might be considered. Octane enhancement additives are described in more detail in Section 5.2.8.2.
- Many stakeholders were concerned that increased refinery energy and greenhouse emissions through production of higher-octane petrol, should be taken into account in this study. Some expressed the view that PULP use should somehow be limited to current and future vehicles having engines optimised for 95 RON.

- Government agencies, the motor industry and the automobile associations expressed concerns about the future relative market price for PULP versus ULP. The motor manufacturers indicated a strong preference to supply vehicles optimised for PULP but provided no firm guidance for the rate of uptake, which would depend greatly on the relative market price. The refiners indicated the equivalent import parity price differential for PULP vs ULP is currently around 2 cents/L, and agreed this differential should be factored into the scenarios to be evaluated.

Some stakeholders in the motor industry expressed a preference to have the freedom to import or locally manufacture vehicles with engines optimised for 98 RON ULP. Other stakeholders expressed no enthusiasm for this.

- The refiners consider 98 RON to be well beyond the optimum fuel efficiency of the overall refinery/vehicle system. Nevertheless, the refiners consider the effects of a 98 RON ULP as a niche market grade, should be considered in the scenarios.

5.2.7 Industry Policy

Many stakeholders referred to the Commonwealth Government's *'Environmental Strategy for the Motor Vehicle Industry'* as indicative of the Government's overall industry policy. Most felt that this strategy (together with probable future tariff reductions) would encourage (or should force) the local motor industry to become progressively even more integrated with global product design and manufacture.

Some government agencies were concerned that the competitive viability of local manufacture may be doubtful in the longer term, if the pace of adoption of international 'state of the art' technologies is too slow. Others were concerned that the viability of local engine design/manufacture might be threatened if forced changes are too rapid. All of these concerns were reflected in various views expressed by the local vehicle manufacturers/importers.

Stakeholders expressed similar concerns in relation to the petroleum refining industry. On the one hand, the long term viability of refiners will depend on their competitive ability to provide high quality market fuels that will support future vehicle technologies. On the other hand, viability of (some) refineries might be threatened by imposition of stringent fuel quality standards.

The refiners indicated that the 'Downstream Petroleum Industry Action Agenda' is currently considering a number of related issues, including –

- competition policy and future industry structure.
- environmental issues.
- taxation and microeconomic issues.

5.2.8 Other Issues

5.2.8.1 Dual Grade Diesel Fuel

Commonwealth and some state agencies considered availability of diesel fuel with 500 ppm maximum sulphur level to be a minimum requirement to support Euro 2

vehicles in the field. Some expressed the view that it may be practical to have low sulphur diesel provided in major city regions only, with country levels somewhat higher during an interim period.

Also, it was considered that very low sulphur diesel, trending to 50 ppm, might be supplied in major city regions to support introduction of vehicles with Euro 3/4 emission controls, again with higher sulphur in country areas for an interim period.

The motor vehicle industry expressed concerns for dual grade 'city/country' diesel distribution, as city vehicles fuelling in country areas would risk catalyst and OBD failures. The supply of low sulphur diesel for 'onroad' (registered) vehicles and higher sulphur diesel for 'off-road' (unregistered) vehicles was considered a more practical approach.

5.2.8.2 Octane Enhancement Additives

The FCAI indicated the use of MTBE as a fuel extender/octane enhancer should be avoided on the basis of degradation of fuel efficiency performance, adverse emission impacts and potential environmental problems. Other additives, such as methanol, can pose problems by attacking fuel system component materials and may cause increased emissions of reactive or toxic compounds. The FCAI strongly advise against the use of MMT, based on Canadian experience where MMT has been shown to adversely affect catalyst performance, spark plug durability and oxygen sensors in exhaust systems.

Some other stakeholders (in passing) mentioned MTBE as a possible useful additive to petrol, albeit with some environmental effects.

NSW EPA indicated there might be value in considering the refinery effects of MTBE in the scenarios.

The AIP advised that refiners are examining all safe options to restore and boost octane, particularly in the face of tightening standards for benzene and other high-octane components.

Some refiners might choose to use MMT and/or MTBE, given the necessary approval from Government to do so, and they seek to open debate on relevant issues.

5.2.8.3 Incentives for Green Fuels and Vehicles

A number of stakeholders in government, the motor industry and the petroleum industry indicated a view that government excise differentials and other financial incentives should be considered –

- incentives for accelerated adoption of new engine technologies (such as petrol/diesel-electric hybrids, and fuel cells).
- incentives for 'green' petrol and diesel.
- incentives for less GH-intensive fuels (such as CNG, LPG and methanol), and renewable fuels (such as ethanol).
- encouragement for use of public transport.

Some stakeholders expressed the view that these incentives should flow (at least in part) to the industries concerned, rather than to the consumer.

As part of the Measures for a Better Environment tax package announced by the Commonwealth Government, funds are to be provided to encourage conversion of 800 buses and 4000 commercial vehicles to CNG/LPG per year over the four year period to June 2004.

5.3 Technical Issues

5.3.1 Euro Emission Standards and Technologies

The FCAI and the individual vehicle manufacturers/importers provided much relevant information in discussion and in various technical papers. In particular, they provided views on generic vehicle/engine/emission control technologies that are currently available or under development within their corporations to meet Euro (and equivalent Japanese and US) standards. These views are summarised below.

Designing for the Euro standards is primarily a NO_x reduction task for petrol vehicles, and a combined NO_x/particulate reduction task for diesel vehicles. NO_x reduction has an inherent fuel penalty, which will slightly reduce the fuel efficiency benefits achievable with rapidly developing technologies.

The technology packages are aimed to provide emission reductions to meet each Euro standard as it is introduced, together with substantial fuel consumption reductions to meet corporate objectives in response to community and government demands.

These technologies will be adopted in Australia in due course, as new vehicle models are introduced and updated. This will occur whether or not Australian emission standards demand it.

Adoption of new technology comes at a cost, which for the local suppliers may be –

- significantly reduced over time, with corporate design/manufacturing experience overseas.
- significantly reduced if accomplished within the manufacturer's model change cycle (which may be different for each model, and for imported vs locally manufactured models).
- substantially increased if driven too quickly by introduction of emission standards.

For petrol vehicles –

- Implementation of Euro 2 emission standards in Australia would present little problem for imported vehicles in the 2002/4 timeframe indicated in MVEC's *'Preferred Option'*. For some locally manufactured vehicles the next model change is already committed for 2003/4, and earlier introduction would be difficult.
- Euro 2 standards may require –

  - revised catalyst specifications.
  - addition of a pre-catalyst.
  - addition of exhaust gas recirculation (EGR).
  - revised engine management systems.

- Implementation of Euro 3/4 (and equivalent US and Japanese) standards is a huge task, on which world-wide technology development is now fully focused.
- Even though Euro 3 vehicles are now being introduced in Europe (ahead of their formal introduction during 2000/2001), there are many uncertainties. Frequent running changes are likely to be made as the technologies mature. Mature Euro 3-technologies may not be readily available from the corporate catalogues for several more years.
- Euro 3 engines will mostly be optimised for 95 RON, some to 98 RON. Some will have a degree of RON tolerance. Designs will incorporate advanced engine and emission control systems, which will include several of the following features –
  - gasoline direct injection (GDI).
  - very high compression ratios (up to 12:1).
  - ultra-lean-burn combustion (A:F out to 50:1).
  - close-coupled pre-catalysts.
  - larger, perhaps multiple catalysts.
  - advanced lean NO_x catalysts.
  - on-board diagnostic (OBD) systems.
  - positive EGR.
  - advanced engine management systems.
  - advanced evaporative control systems.
  - knock detection.
  - variable cam timing.
- Vehicles/engines with Euro 3-technology will be progressively introduced in Australia over the next several years, as the range of complying corporate designs expands. For locally manufactured engines, technology adoption ahead of the model change cycle in about 2006/7 may be difficult and costly.
- Euro 4-technology would likely comprise mainly incremental developments beyond Euro 3. It may also include some more radical engine design changes.

All diesel vehicles/engines are imported –

- The smaller vehicles are almost entirely sourced from Japan. Current Japanese diesel emission standards are less stringent than Euro 2, but this will change with introduction of new standards from 2001. Japan/MITI has agreed to adopt Euro 3 for diesels in 2003/4. Meeting Euro 2 or 3 in the time frame of MVEC's *'Preferred Option'* is therefore achievable, but at a cost. There may be some difficulties with particular vehicles –
  - Some vehicles supplied in Australia are unique to satisfy local performance and durability requirements. Whilst they have engines specified for Japanese or Euro requirements, they have combinations of body, engine,

transmission and suspension systems that differ from those supplied in Japan or Europe (or USA).
    - Such vehicles will require development/re-specification, and re-certification.
- For smaller diesel vehicles, Euro 2 will require catalysts. Some vehicles will also have electronic engine management. Euro 3/4 engines may include –
    - common rail injection systems.
    - electronic engine management.
    - advanced catalyst systems.
    - on-board diagnostics.
    - some may be fitted with particulate traps.
    - some may have turbocharged/intercooled engines.
- For heavy diesel vehicles, there is little problem in complying with Euro 2 or 3 (or equivalent US) requirements, since almost all engines/vehicles are imported from USA or Europe. Some recently imported vehicles/engines are already to Euro 2 specification. By 2005/6 all heavy diesel importers will have access to Euro 4 engines (or the equivalent US).
- For heavy diesel vehicles, Euro 2 standards may require revisions to engine management and fuel injection systems. Most heavy vehicle engines are already turbocharged and intercooled. Euro 3/4 engines may include
    - common rail injection systems.
    - Advanced electronic engine management.
    - advanced catalyst systems.
    - on-board diagnostics
    - some may be fitted with particulate traps.

The industry is very actively developing engines with improved performance on alternative fuels, in particular –

- LPG has up to 20% greenhouse gas emission advantage over petrol. LPG technology is immature and currently still expensive. CNG has a 16% greenhouse advantage over petrol.
- CNG and LNG are considered potential replacement fuels for heavy diesels. In the main, the technology is not yet sufficiently well developed for long distance use, and cannot yet compete with heavy diesel efficiency and durability. Caterpillar has developed advanced spark-ignition CNG and LNG technologies, and compression-ignition (diesel pilot) CNG and LNG technologies for its engines, which show considerable promise. These engines have considerably lower particulate, NO_x and CO_2 emission levels, and are close to meeting the proposed US 2004 emission requirements. A few are now running in Australia.
- The use of ethanol is not considered economical, compared to petrol or diesel.

The industry is developing a number of more radical vehicle/engine technologies, the most promising of which are –

- Diesel-electric or petrol-electric hybrids show good promise. Toyota has recently introduced a production vehicle, the ‘Prius’, on the Japanese, European and US

markets. The 'Prius' incorporates hybrid technology having a petrol engine which includes gasoline direct injection, lean O_2 sensor, and advanced NO_x storage catalyst. The 'Prius' has not been specified for the ADRs and cannot (at least for some time) be offered in Australia. Other manufacturers have similar hybrid designs in prototype or pre-production versions.

- Fuel cell developments have been very rapid. Pre-production models are likely to be trialled during the next few years. Designs may well be commercial during the mid to latter part of the next decade with perhaps 50% new vehicle penetration by 2020.

5.3.2 Fuel Quality Requirements

The automotive industry and all other stakeholders consider there is an urgent need to upgrade Australian fuel quality standards.

For diesel fuel, stakeholders consider sulphur to be the main quality issue having immediate and growing impacts on vehicle performance and durability.

- Sulphur has a direct impact on diesel exhaust particulate. Reducing diesel sulphur will therefore immediately reduce particulate emissions from the entire diesel fleet.
- Several stakeholders in government and in the automotive industries considered high sulphur diesel may have significant engine maintenance disbenefits. One vehicle supplier reported that the current quality of Australian diesel compromises engine selection and causes durability problems in EFI systems, fuel pumps and injectors, which can lead to reduced performance and higher smoke emissions. More frequent servicing is required to support a 3-year warranty period (eg oil change intervals at 5000 kms in Australia vs 15000 km in Europe).
- Some in the automotive industry cautioned that for older engines, ultra-low sulphur diesel may lead to higher wear rates in fuel injection systems, which in part rely upon sulphur for lubricity. Ultra-low sulphur diesel will require a lubricity additive.
- Euro 2 diesel vehicle emission standards are based upon 500 ppm maximum fuel sulphur (compared to current Australian pool average of around 1300 ppm reported by the AIP). An increasing number of heavy diesel vehicles with Euro 2 technologies, are now being imported. Many stakeholders are concerned these vehicles will not achieve their designed low particulate (or perhaps NOx) levels on current Australian fuel.
- Some smaller Euro 2 technology vehicles require catalysts, primarily for NOx reduction. Catalyst activity may quickly deteriorate if fuel sulphur levels are too high. Most stakeholders were of the view that 500 ppm maximum sulphur diesel is required to support introduction of Euro 2 standards in Australia.
- Euro 3/4-technology for diesel vehicles includes advanced catalyst and on-board diagnostic systems, and may include particulate traps. Information provided by stakeholders indicates these systems may be deactivated by fuel sulphur significantly higher than the equivalent Euro fuel standards, with consequent increase in emission levels and failure of OBD systems. The automotive industry considers sulphur levels need to be reduced through the equivalent Euro 3 (350

ppm) and Euro 4 (50 ppm) levels to support these technologies. The automotive industry considers 30 ppm maximum sulphur is desirable to provide full protection for Euro 4 technology and beyond. Other stakeholders, particularly in the petroleum industry, question the need for sulphur to be reduced as low as 50 ppm, especially in view of the high refinery investment and energy requirements in deep hydrodesulphurisation.

- Very few stakeholders expressed a view on any other diesel quality parameters.

For petrol, stakeholder concerns relate primarily to future rather than current market quality. Volatility, RON and sulphur are the main issues but there are some concerns within governments, relating to benzene and other components.

- Most stakeholders indicated high petrol volatility is the only immediate issue, due to consequent high evaporative emissions from motor vehicles. The motor industry considers petrol volatility should be regarded as a priority fuel issue, independently of any future emission standards. Modest reduction in summer (and winter)-time volatility would produce significant reduction in hydrocarbon emissions, toxics and in ozone formation potential (*EA/FORS Fuel Volatility Project*). This must be a balanced approach as too great a reduction may give driveability or starting problems. Government stakeholders consider RVP reductions should be negotiated with the petroleum industry on a state by state basis, as has already occurred in NSW.
- Oil industry data indicate that current petrol quality in Australia meets Euro 2 quality standards.
- The vehicle suppliers indicated that with introduction of Euro 2 standards in Australia, they would prefer to optimise many or even most new vehicles (both imported and locally manufactured) for 95 RON PULP, thus enabling achievement of optimum fuel efficiency. However, they indicated that the future market price for PULP vs ULP would need to be reduced for this choice to be made. The AIP has agreed to factor into the scenarios a differential market price equal to the import parity price differential.
- Vehicle suppliers also indicated they would like the freedom to introduce some future models with 98 RON optimisation. Government stakeholders were not enthusiastic about such a move, considering it would not assist in achievement of overall government objectives. The petroleum refiners considered 98 RON would be well beyond the optimum for overall refinery/vehicle efficiency, but indicated their preparedness to consider a 98 RON niche grade in the scenarios.
- The motor industry indicates that while Euro 3 technologies are being proven effective in achieving very low emissions with substantially reduced fuel consumption, they are very sensitive to fuel sulphur. In particular, the activity of advanced lean-NOx catalyst formulations, lean oxygen sensors, and OBD sensors can become progressively and quickly inhibited, even with quite low levels of sulphur. Euro 4 technologies under development, are even more sensitive to sulphur. The motor industry considers petrol sulphur levels need to be reduced through Euro 3 (150 ppm) and Euro 4 (50 ppm) levels to support these technologies. As with diesel, the industry consider a maximum sulphur level of 30 ppm is desirable to fully support Euro 4 technologies and beyond.

- The motor industry provided several technical papers relevant to sulphur sensitivity. In particular, it provided copy of a US EPA technical Paper *'EPA Staff Paper on Gasoline Sulfur Issues'* May 1 1998, which appeared to be the most relevant and authoritative. This paper indicates the complexity of the technical issues and reaches no firm conclusions. It does though appear to support views that –
    - sulphur sensitivity (at least in the range considered, 40 to 150 ppm) may be greatest for advanced engine/emission control technologies (LEVs and ULEVs), and in particular those having ultra-lean combustion and lean-NOx control technologies.
    - the most reactive catalyst systems, capable of the greatest emission reductions, are the most susceptible to sulphur inhibition.
    - developing fuel cell technologies may also be very sensitive to sulphur. (In technologies using hydrogen generation from petrol, hydrogen may be contaminated by sulphurous gases formed from the fuel sulphur.)
    - OBD sensors are also highly sensitive to sulphur.
    - reversal of sulphur inhibition (by running on ultra-low sulphur after contamination on higher sulphur fuel) may not be achieved in normal driving conditions.
- Most government agencies expressed concerns that some petrol components (benzene, aromatics and olefins) may increase regulated exhaust emissions and may lead to higher levels of some unregulated toxic and reactive compounds. While limits on these components are desirable, matching the Euro 3 limits and especially the Euro 4 limits might be too costly to justify. It was suggested the scenarios should enable estimation of costs of meeting Euro 4 limits for these components, compared to other, softer targets. The petroleum refiners indicated these components are important in cost-effective achievement of higher-octane levels.

5.4 Baseline And Scenarios For Evaluation

Stakeholders generally were of the view that all policy and technical issues should be taken into account in developing scenarios. The scenarios should not be limited by previously identified difficulties or costs. They should embrace all seriously canvassed options.

5.4.1 Base Case

Stakeholders considered the base case should represent business as usual, and should include continuation of current programs, and all established or announced policy settings–

- ADR 37.01 and ADR 70 continuing.
- 10% NAFC reduction for cars from 1990 level by 2000.
- Commonwealth agencies considered continuation of the current NAFC agreement, at a rate of 1% per year to 2010, is a baseline condition. The motor industry does not necessarily accept this view.

- Current fuel qualities continuing but with sulphur and volatility reductions in train or planned for market reasons, or as may have been agreed between the petroleum industry and the states.
- MVEC considers progression on a voluntary basis to provision of 500 ppm sulphur diesel fuel by 2002, initially in city regions, is a reasonable base case assumption. The Petroleum industry does not accept this view.
- early phase-out of leaded petrol.
- business as usual growth in VKT.

NSW EPA considered the current policy settings should include all items in the Commonwealth's *'Environmental Policy for the Motor Vehicle Industry'* announced by the Prime Minister in November 1997 –

- Euro 3 emission standards to be implemented in 2002/2003 and Euro 4 to be implemented by 2006, to achieve full harmonisation with International standards, (and from then on, the implementation of further relevant standards on schedule with Europe).
- 15% reduction in NAFC for passenger cars, 4WDs and light commercial vehicles by 2010.
- (by implication) fuel quality requirements as necessary to allow the introduction of Euro 3 and 4 vehicles, with regard to octane, RVP and sulphur (for petrol), and sulphur for diesel.
- accelerated adoption of CNG (especially to replace diesel in heavy vehicles) and other alternative fuels, with continuing support and encouragement by State and Commonwealth Governments.

5.4.2 MVEC 'Preferred Option'

MVEC requested its *'Preferred Option'* be included as a scenario. Most stakeholders considered this to be essential.

There were no suggestions from stakeholders that any less stringent scenario (other than the base case) should be considered.

5.4.3 'Most Stringent Case'

The AIP considered a 'most stringent case' scenario should be adopted, which should include progression to Euro 4 fuel specifications by 2006, with further progression to a lower sulphur level for petrol and diesel. The AIP considered this a 'worst case' scenario.

Most stakeholders supported this view.

The motor industry considers 30 ppm maximum sulphur (as specified in the industry's *'World-Wide Fuel Charter'* is the desirable longer term target for both petrol and diesel.

NSW Agencies expressed a strong view that the impacts of some more radical possibilities need to be considered. The impact of greenhouse gas emissions and

rising green consumerism represented one potential scenario that may have a major impact on the oil refining industry. The scenarios must include a 'lower growth' option. At the least, this must include a scenario where GHG emissions are contained to no more than 108% of 1990 emissions by 2010 (ie the overall GHG targets agreed by Australia in the Kyoto Protocol).

5.4.4 Other Scenarios

Stakeholders considered that other scenarios should consider fuel options with intermediate timing (in respect of sulphur levels) and stringency (for other fuel parameters) between MVEC's 'Preferred Option' and the 'Most Stringent Case'. The particular parameters mentioned, mainly by government agencies and the petroleum refiners, were –

- benzene, aromatics and olefins in petrol.
- density and PAH in diesel.

6 LINK TO SCENARIO DEVELOPMENT

The Review Team acknowledges the frank and willing contributions made by all stakeholders in this Consultation phase of the Review.

All views expressed have been carried through to the Scenario Development process.

PART 2: SCENARIO DEVELOPMENT

7 BACKGROUND TO SCENARIO DEVELOPMENT

During April and May 1999, the Review Team consulted with a broad range of stakeholders including many within government, the automotive industry and the petroleum industry, to solicit views on future fuel quality scenario development.

During that same period, MVEC finalised its '*Review of Motor Vehicle Emission Standards, Recommendations to NRTC and NEPC'*, which was circulated to the Review Team on 26 May. MVEC anticipates that necessary Government decisions will be made to allow amendments to the ADRs before the end of 1999.

On 28 May 1999, the Government and the Democrats reached agreement on a range of issues within the Government's taxation proposals, *'A New Tax System (ANTS)'*. This *'Tax Package Agreement'* involves a number of amendments to ANTS that will have impact on future vehicle emissions and fuel standards.

MVEC has subsequently revised its recommendations to NRTC and NEPC, and circulated a paper *'Revised Emissions and Fuel Standards Package'* to the Review Team. This paper presents a revision of MVEC's 'Preferred Option' to incorporate the Prime Minister's commitments under the *'Measures for a Better Environment'* element of the '*Tax Package Agreement*'.

The ANTS legislation, incorporating the *'Tax Package Agreement',* was passed by the Parliament in late June 1999.

Environment Australia has directed the Review Team to take account of the Government's *'Measures for a Better Environment'* and MVEC's *'Revised Emissions and Fuel Standards Package',* in developing scenarios for evaluation in this Review.

Also, Environment Australia has emphasised that scenarios must be relevant to the issues, and credible to the Government and all stakeholders. In particular, at least one scenario should be targeted to indicate the effects of possible future cooperative arrangements, or rationalisation, within the refining industry. Environment Australia has asked the Review Team to consult with the AIP on the development of such a scenario for the Project Steering Committee's approval. It was acknowledged that a 'rationalised' scenario will take time to be developed, but that this need not delay submission of other scenarios for approval.

This paper presents proposed scenarios that reflect the bulk of views put to the Review Team by Stakeholders. These scenarios take account of –

- MVEC's *'Revised Emissions and Fuel Standards Package'.*
- Other relevant provisions of the Government's *'Measures for a Better Environment'.*
- Concerns expressed by Environment Australia with respect to future cooperative arrangements or rationalisation within the refining industry.

8 RATIONALE FOR THE SCENARIOS

8.1 'Base Case' – Scenario 1

It is considered that the base case should encompass the continuation of current policy settings but should include a number of other assumptions outlined below.

- The Commonwealth Government's Environmental Strategy for the Motor Vehicle Industry (November 1997) notes that the phase out of leaded fuel will 'be brought forward'. Based on the trend in declining market share, and for the purpose of this modelling exercise, it has been assumed that the phase out of leaded petrol will be completed during 2002.
- It should be noted that, in relation to Western Australia, BP has recently agreed to phase out leaded petrol, and reduce levels of MTBE and benzene in petrol from 1 January 2000. In relation to Victoria, Shell has announced that it plans to phase out leaded petrol in 'late 2000'.
- Reductions in petrol volatility are in train or planned, following negotiations with State authorities.
- MVEC's proposal to allow ECE (Euro) certification from 2000 implies increasing volumes of 95 RON ULP (PULP) to meet increasing demand from imported (and some locally produced) vehicles.
- The AIP advises that the import parity price differential for 95 RON PULP vs 91 RON ULP is approximately 2 c/litre. This is relevant for evaluation of the Base Case and all other scenarios, for which a similar 2 c/litre differential retail price is assumed to be in effect from 1/2/2002. Clearly, this will drive growth in the use of PULP in all scenarios. Given this assumption, it is proposed to seek information from the FCAI on the likely future demand for PULP vs ULP to supply new vehicles entering the market through the period to 2010.
- The Base Case will take account of the auto industry NAFC target of a 10% reduction to 2010 as a base.
- The Base Case will include reductions in sulphur in train or planned, *as agreed by individual companies*. For BP, this will include road transport diesel at –
  - 500 ppm urban / 2000 ppm country in WA from 1/1/2000;
  - 500 ppm urban in Brisbane from 1/7/2000 / position on country level to be clarified by BP.

  For other refiners this will include road transport diesel at –
  - 1000 ppm pool average urban / 2000 ppm pool average country, with +500 ppm caps, from 1/1/2000.
- For off-road diesel fuel, it is assumed there will be no change from current standards.

The 1997 average pool qualities of petrol and diesel at Australian refineries are summarised in Table 2.

Table 2: Australian Refineries: 1997 Average Pool Qualities of Petrol and Diesel[1]

Company		All	Caltex		BP		Mobil		Shell	
Refinery Location		Aust Avg.	Lytn. QLD	Kurn NSW	Bulw QLD	Kwin WA	Altona VIC	S'vac SA	Geel VIC	Clyde NSW
Petrol :										
Production	M.tpa	13.1	1.9	2.3	1.1	1.6	1.8	1.0	1.7	1.6
RON-0		92.3	92.1	92.0	92.0	93.0	92.3	92.0	92.8	93.4
MON-0		82.6	82.6	82.4	82.3	82.9	83.1	83.7	82.4	82.3
Benzene	% vol	2.9	2.4	2.4	2.9	2.1	4.3	3.4	2.9	2.7
Aromatics	% vol	31	30.6	34.1	30.6	33.3	31.6	30.9	25.8	28.4
Olefins	% vol	13	12.6	16.5	10.5	8.9	12.6	1.0	12.6	17.0
Sulphur	ppm	193	70	181	350	292	216	22	90	224
RVP, Nov to Feb	kPa	73	75.5	72.7	73.3	71.1	70.5	66.9	72.9	77.8
Density	kg/m^3	734	736	734	732	729	737	740	729	740
FBP	deg.C	192	186	201	191	184	187	193	176	217
On-road Diesel :										
Production	M.tpa	10.2	1.4	1.2	0.9	2.1	1.2	0.8	1.6	1.1
Sulphur	ppm	1500	380	1400	2100	2100	1000	900	1600	2200
Cetane Index		51.1	50.2	50.0	50.4	49.5	51.9	58.8	48.6	51.0
PAH	% m	3.5	n/a	n/a	2.2	4.0	n/a	n/a	n/a	n/a
T-95	deg.C	349	339	343	n/a	n/a	357	366	n/a	n/a
Viscosity, 40 ^oC,	mm^2/s	3.2	3.1	3.2	n/a	1.9	3.2	3.2	2.9	3.5
Density	kg/m^3	847	843	852	842	845	847	835	850	855

1: AIP (1997).

Aust avg: Australian average
Lytn: Lytton
Kurn: Kurnell
Bulw: Bulwer
Kwin: Kwinana
S'vac: Port Stanvac
Geel: Geelong

8.2 'MVEC/MBE (Explicit) Option' – Scenario 2

It is proposed that Scenario 2 will be as the 'Base Case', with the following additions:

- A further 15% reduction in NAFC through the period 2000 to 2010, taking account of the Government's commitment in its *'Environmental Strategy for the Motor Vehicle Industry', 1997*.
- MVEC (in its original proposal) indicated its *'Preferred Option'* as one of the scenarios to be modelled in this Review. MVEC's *'Revised Preferred Option'* and relevant provisions of the Government's *'Measures for a Better Environment'* are incorporated.
- Only the fuel parameters and timelines explicitly set out in the MVEC/MBE package will be considered, that is:

- the sulphur content of diesel fuel; and
- assumptions in relation to petrol as for the base case.

- Euro 3 sulphur levels (150 ppm) for petrol introduced in 2005, to coincide with MVEC's proposed Euro 3 emission standard for petrol vehicles in 2005/6.
- Subsection 4(3) of the *Diesel and Alternative Fuels Grants Scheme Act 1999* states:

In the case of diesel fuel, the Commonwealth intends to restrict entitlements available under the Energy Grants (Credits) Scheme to ultra low sulphur diesel from 1 January 2006, when a mandatory standard to 50 ppm sulphur will come into effect.

This will apply in relation to both on-road and off-road uses of diesel, as the Energy Grants (Credits) Scheme will replace the current Diesel Fuel Rebate Scheme (applying to off-road uses) as well as introducing certain grants to on-road uses of diesel. Therefore, 50 ppm sulphur diesel will be assumed from 1 January 2006.

- Existing off-road diesel standards will be assumed to continue prior to 2006.
- It is assumed, for the purposes of modelling, that the excise advantages for 50 ppm sulphur diesel during the period 2002/5 are intended to flow on to consumers.

8.3 'Best Endeavours - MVEC/MBE (Implicit) Option' – Scenario 3

It is proposed that Scenario 3 will be as Scenario 2, with the following additions –

- The introduction of Euro 3 petrol in 2005, with parameters other than sulphur concentration, RON and RVP set on a refinery best endeavours basis. The Euro 3 specifications for petrol are outlined in Section 10.4.
- The introduction of Euro 4 petrol in 2008, with parameters other than sulphur concentration and RVP set on a refinery best endeavours basis.
- The introduction of Euro 4 diesel in 2006, with specific requirements for 50 ppm sulphur.
- Only the sulphur and specifications for petrol and diesel (50 ppm) and the aromatics for gasoline (35% vol) have been set for Euro 4. Where Euro 4 specifications for other identified components are not yet available, it has been agreed that the specifications shown in Tables 3 and 4 in section 9.2 (Euro 4 Fuel Specification) will be used for the purposes of modelling.
- Other important parameters (For petrol: benzene, distillation, aromatics, olefins; for diesel: cetane, density, aromatics, PAH, T90) will be discussed with each refiner to determine the approximate cost/benefit break points (which may be different for each refinery). Specifications will be set for each refinery taking account of these breakpoints.
- The cost of dosing with a lubricity additive will also be explicitly developed for this scenario.
- Many stakeholders (particularly in Government) expressed concerns about the GHG emission consequences of projected growth in transportation. Therefore, it is proposed to conduct sensitivity analyses on this scenario to indicate the relative

fuel costs and emission benefits of lower growth. Here, it is assumed that overall average GHG commitments set in the Kyoto Protocol would be met (ie by scaling back fuel production/demand to give total projected CO_2-equivalent emissions equal to 108% of 1990 emission levels by 2010).

8.4 'Mandatory - MVEC/MBE (Implicit) Option' – Scenario 4

It is proposed Scenario 4 will be as Scenario 3, except with all the Euro fuel parameters to be mandatory and not on a best endeavours basis.

- The incremental cost of meeting each of the Euro fuel specifications will be identified.
- The AIP considers that 50 ppm sulphur diesel will require a lubricity additive, which will add to the cost. 500 ppm sulphur diesel may not, but would need to be tested to be certain. Otherwise the additive may be needed on conservative grounds, also adding to cost.) Indicative industry cost for 50 ppm sulphur dosing is likely to be of the order of $10M. This will be explicitly developed as part of this scenario.
- In order to take account of concerns expressed by Environment Australia and others, it is proposed that as an addition to this scenario the Review Team will make estimates of the benefits that could be obtained by cooperation and linkage of the three East Coast pairs of refineries. Each refining company has agreed to assist by nominating an individual who will separately meet with the Review Team to provide a 'reality check' of assumptions made. As this is only a cost issue, and not one of quality or volume, it does not need a separate scenario.

8.5 'Euro 4 Transport Fuels By 2006' – Scenario 5

It is proposed that Scenario 5 will be as Scenario 4 except as follows.

- All parameters for petrol and transport diesel will be set to Euro 4 specifications from 1/1/2006.
- Where specifications for the other identified components are not available, the specifications tabulated in Section 8.3 of this report will be used for the purposes of modelling.
- Assume 98 RON fuel use by new vehicles produced from 2008.

8.6 'Most Stringent Case' – Scenario 6

It is proposed that Scenario 6 will be as Scenario 5, with the following additions –

- a requirement for 30 ppm sulphur in petrol and diesel (as suggested in the Auto Industry's *'World-Wide Fuel Charter'*) is assumed to be applied from 2008.

9 OTHER CONSIDERATIONS

9.1 Octane Enhancement Additives

The AIP has advised that some refiners at least, would chose to use MMT and/or MTBE for petrol octane enhancement, given the necessary approval from Government to do so. The use of these additives is permitted within the Euro fuel specifications, and would be particularly important in those scenarios where Euro 4 petrol (with <1% benzene) is included. It is noted that MMT is also an effective lead replacement additive for older engines. The AIP considers debate on issues in respect of both additives should be opened.

The FCAI strongly advise against the use of MMT additives because of Canadian experience where MMT was shown to adversely affect catalyst performance, spark plug durability and sensors for on board diagnostics. The FCAI also considers MBTE should be avoided on the basis of degradation of fuel efficiency performance, adverse emissions impacts and the potential for environmental problems due to the high solubility of MBTE.

It is proposed to develop costs both with and without these additives, at each refinery where their use may be a consideration. Other strategies for achieving desired octane levels will be discussed in the final report.

9.2 Euro 4 Fuel Specifications

Euro 4 fuel specifications are not yet finalised by the EU Council and Parliament. The specifications to be used for modelling purposes are shown in Tables 3 and 4.

Table 3: Euro 4 Petrol Specifications and Agreed Levels (for Modelling Purposes) of Components Not Yet Specified for Euro 4

Parameter	Specification
Sulphur, %mass max	0.005*
RON min	95
MON min	85
Benzene, %vol max	1
Aromatics, %vol max	35*
Olefins, % vol max	14
FBP, ^{0}C, max	205

*: Specification has been set for Euro 4.
FBP: Final Boiling Point

Table 4: Euro 4 Diesel Specifications and Agreed Levels (for Modelling Purposes) of Components Not Yet Specified for Euro 4

Parameter	Specification
Sulphur, %mass max	0.005*
Density, kg/L max	0.845
Cetane Number, min	55
Cetane Index, min	52
T95, ^{0}C, max	350
PAH, %mass, max	4

*: Specification has been set for Euro 4.
T95: Distillation temperature at which 95% of the fuel has evaporated
PAH: Polycyclic Aromatic Hydrocarbons

9.3 Pool Averaging

EU has adopted maximum limits for relevant parameters in its specifications for fuel quality, whereas the US has adopted a 'pool' system. The AIP indicates a strong preference for 'pool' specifications on an airshed basis.

- The principle of setting an average with a reasonable cap, has been agreed in the volatility reduction MOU in NSW.
- For the Base Case and Scenarios 2 and 3, it is proposed to adopt a 'pool' system for those scenarios with specifications which are a relaxation from the Euro standards, except for sulphur levels. This would include a cap and an industry (pool) annual average within the airshed. (The only seasonal specification is volatility, where monthly averaging is appropriate.)
- Sulphur levels are maximum limits and are not amenable to a pool approach.
- The 'pool'system will not be used for Scenarios 4, 5 and 6, where all parameters are mandated.

9.4 Projecting Demand Growth In 95 RON PULP

Growth in demand for 95 RON PULP will largely be driven by the assumption of a 2 c/L PULP/ULP differential in all scenarios, based on import price parities. In order to model PULP/ULP demand volumes, it will be necessary to make assumptions on the proportions of new vehicles (together with their likely model average fuel consumption) that will be optimised for PULP and ULP. The FCAI have indicated that between 2000 and 2002 vehicle owners would be expected to continue to use 91 RON unless incentives are provided to encourage the use of 95 RON.

It is proposed to assume 95 RON fuel usage for all new imported vehicles from 2005/6 for Scenarios 2 to 6.

9.5 98 RON ULP

The FCAI believes that 98 RON is essential to assist in achieving NAFC reductions and Euro 4 fuel specifications. AIP members are not in favour of a move to 98 RON, believing it to be beyond the optimal RON for overall greenhouse performance. The costs and emissions implications may need to be identified in this Review.

It is proposed to assume 98 RON for all new vehicles from 2008/9 for Scenarios 5 and 6.

9.6 Dual Grade Diesel Distribution

MVEC's proposal covers road transport fuels only (ie. registered vehicles), which leaves open the possibility of a dual grade (on-road/off-road) distribution for diesel. As part of the scenario evaluation, each refiner will provide commentary and cost estimates for on-road/off-road and city/country options prior to mandatory dates, and options for delivering off-road diesel at on-road quality as a tradeoff against infrastructure costs.

It is proposed to seek advice from diesel engine suppliers on what if any limitations should be applied for off-road diesel quality, in particular for mining and agricultural plant and equipment.

9.7 Likely Capital Cost Estimates

AIP has advised that the capital costs likely to be derived through this Review, will be lower than were estimated by members in earlier studies. This is because of the rapid change in technological development and resultant cost reduction. Concawe 99/56 study, just released, states "Concawe's view of the cost of diesel fuel sulphur reduction up until recently were somewhat overstated because not enough allowance was made for emerging new advances of gas oil hydrodesulphurisation technology (new catalysts etc)."

10 PROPOSED SCENARIOS IN DETAIL

10.1 Scenario 1 - Base Case

- Vehicle assumptions –
  - ADR 37.01 and ADR 70 ongoing.
  - Allowance of Euro 2 and 3 as alternates to ADR37.01, from 2000.
  - 10% NAFC reduction 1990 to 2000 for cars.
  - Additional 10% NAFC reduction (1% per year) 2000 to 2010 for cars.
  - Continuation of current trends in fuel mix (petrol/diesel/LPG/CNG).
  - Business as usual growth scenario for VKT.

- Petrol quality assumptions: current standards ongoing except –
  - Leaded petrol phased out by 1/1/2003.
  - Increase in PULP demand for imported (and some locally produced) Euro 2/3 vehicles during 2000/2002.
  - Further increase in PULP demand from 2002, in response to a reduction in the PULP/ULP retail price differential to 2 c/litre.
- Reductions in petrol volatility/sulphur in train or planned, following agreements with the States.
- Road transport diesel quality assumptions: current standards ongoing except reductions in sulphur in train or planned, *as agreed by individual companies*. For BP, this will include –
  - 500 ppm urban / 2000 ppm country in WA from 1/1/2000;
  - 500 ppm urban in Brisbane from 1/7/2000, position on country level to be clarified by BP.

  For other refiners this will include –
  - 1000 ppm pool average urban / 2000 ppm pool average country, with +500 ppm caps, from 1/1/2000.
- Off-road diesel quality assumptions –
  - no changes from current standards.

10.2 Scenario 2 - MVEC/MBE (Explicit) Option

- Vehicle assumptions -
  - ECE compliance allowed as an alternative to ADR 37.01 from 2000 (= base case).
  - Euro 2 for all petrol vehicles < 3.5 tonnes (US 1996 HDV for >3.5 tonnes) from 2003/4.
  - Euro 3 for all petrol vehicles < 3.5 tonnes (US 1996 HDV for >3.5 tonnes) from 2005/6.

- View to adopt Euro 4 for petrol vehicles at a later date (after review in 2000/2001). For the purposes of analysis of this scenario it is assumed that Euro 4 standards for petrol vehicle are not adopted prior to 2010.
- 10% NAFC reduction 1990 to 2000 for cars (= base case).
- Additional 10% NAFC reduction 2000 to 2010 for cars (= base case).
- Additional 15% NAFC reduction 2000 to 2010 for cars, 4WDs and LCVs >3.5 tonnes.
- Euro 3 for all medium and heavy diesel trucks (>3.5 tonnes)(with US 98 as alternate) from 2002/3.
- Euro 2 for diesel passenger cars, light trucks and buses (<3.5 tonnes) from 2002/3.
- Euro 4 for all diesel vehicles (with US 2004 as alternate) from 2006/7.
- Increasing conversions to CNG/LPG in response to Government subsidies for vehicles >3.5 tonnes. (Up to 800 buses, 4000 commercial vehicles per year over the first four years).
- Business as usual growth scenario for VKT (= base case).

- Petrol quality assumptions –
  - Leaded petrol phased out by 1/1/2003 (= base case).
  - Increase in PULP demand for imported (and some locally produced) Euro 2/3 vehicles during 2000/2002 (= base case).
  - Further increase in PULP demand from 2002, in response to a reduction in the PULP/ULP retail price differential to 2 c/litre (= base case).
  - 95 RON for all new vehicles from 2005/6.
  - Reductions in petrol volatility in train or planned, following agreements with the States (= base case).
  - Euro 3 sulphur level (50 ppm) to be introduced in 2005, coinciding with MVEC's proposed Euro 3 emission standards for petrol vehicles in 2005/6.

- Road transport diesel quality assumptions –
  - Voluntary reduction of sulphur in urban areas to 500 ppm through 2000/2, on a best endeavours basis.
  - Sulphur set at 500 ppm (= Euro 2 sulphur level) from 1/12/2002.
  - 1 c/L excise advantage for 50 ppm sulphur diesel during 2003.
  - 2 c/L excise advantage for 50 ppm sulphur diesel during 2004/5.
  - Sulphur set at 50 ppm (= Euro 4 sulphur level) from 2006.

- Off-road diesel quality assumptions –
  - 50 ppm sulphur from 2006. Current specifications continuing prior to 2006.

10.3 Scenario 3 – Best Endeavours - MVEC/MBE (Implicit) Option

- Vehicle assumptions -
  - ECE compliance allowed as an alternative to ADR 37.01 from 2000 (= base case).
  - Euro 2 for all petrol vehicles < 3.5 tonnes (US 1996 HDV for >3.5 tonnes) from 2003/4 (= Scenario 2).
  - Euro 3 for all petrol vehicles < 3.5 tonnes (US 1996 HDV for >3.5 tonnes) from 2005/6 (= Scenario 2).
  - Euro 4 for all petrol vehicles from 2008/9.
  - 10% NAFC reduction 1990 to 2000 for cars (= base case).
  - Additional 10% NAFC reduction 2000 to 2010 for cars (= base case).
  - Additional 15% NAFC reduction 2000 to 2010 for cars, 4WDs and LCVs >3.5 tonnes.
  - Euro 3 for all medium and heavy diesel trucks (>3.5 tonnes)(with US 98 as alternate) from 2002/3 (= Scenario 2).
  - Euro 2 for diesel passenger cars, light trucks and buses (<3.5 tonnes) from 2002/3 (= Scenario 2).
  - Euro 4 for all diesel vehicles (with US 2004 as alternate) from 2006/7 (= Scenario 2).
  - Increasing conversions to CNG/LPG in response to Government subsidies for vehicles >3.5 tonnes. (Up to 800 buses, 4000 commercial vehicles per year over the first four years) (= Scenario 2).
  - Business as usual growth scenario for VKT (= base case).

- Petrol quality assumptions –
  - Leaded petrol phased out by 1/1/2003 (= base case).
  - Sulphur 500 ppm (= Euro 2 sulphur level) from 2002
  - Euro 3 petrol from 2005. Specifications for parameters other than sulphur concentration, RON and RVP to be set on a refinery best endeavours basis (based on best cost/benefits breakpoints for each refinery). Euro 3 specifications for petrol are outlined in Section 10.4.
  - 95 RON for all new vehicles from 2005/6.
  - Euro 4 petrol from 2008 on best endeavours basis, as for 2005 adoption of Euro 3. The Euro 4 specifications for petrol to be adopted for modelling purposes are outlined in Section 9.2.
  - Increase in PULP demand for imported (and some locally produced) Euro 2/3 vehicles during 2000/2002 (= base case).
  - Further increase in PULP demand from 2002, in response to a reduction in the PULP/ULP retail price differential to 2 c/litre (= base case).
  - Reductions in petrol volatility in train or planned, following agreements with the States (= base case).

- Road transport diesel quality assumptions –

- Voluntary reduction of sulphur in urban areas to 500 ppm through 2000/2, on a best endeavours basis (= Scenario 2).
- Sulphur set at 500 ppm from 1/12/2002 (= Scenario 2).
- 1 c/L excise advantage for 50 ppm sulphur diesel during 2003 (= Scenario 2).
- 2 c/L excise advantage for 50 ppm sulphur diesel during 2004/5 (= Scenario 2).
- Euro 4 diesel from 2006, with specific requirement for 50 ppm sulphur. Specifications for parameters other than sulphur to be based on best cost/benefit breakpoints for each refinery. The Euro 4 specifications for diesel to be adopted for modelling purposes are outlined in Section 9.2.

- Off-road diesel quality assumptions –
  - 50 ppm sulphur from 2006. Current specifications continuing prior to 2006.

10.4 Scenario 4 – Mandatory - MVEC/MBE (Implicit) Option

- Vehicle assumptions -
  - ECE compliance allowed as an alternative to ADR 37.01 from 2000 (= base case).
  - Euro 2 for all petrol vehicles < 3.5 tonnes (US 1996 HDV for >3.5 tonnes) from 2003/4 (= Scenario 2).
  - Euro 3 for all petrol vehicles < 3.5 tonnes (US 1996 HDV for >3.5 tonnes) from 2005/6 (= Scenario 2).
  - 10% NAFC reduction 1990 to 2000 for cars (= base case).
  - Additional 10% NAFC reduction 2000 to 2010 for cars (= base case).
  - Additional 15% NAFC reduction 2000 to 2010 for cars, 4WDs and LCVs >3.5 tonnes (= Scenario 3)
  - Euro 3 for all medium and heavy diesel trucks (>3.5 tonnes)(with US 98 as alternate) from 2002/3 (= Scenario 2).
  - Euro 2 for diesel cars, light trucks and buses (<3.5 tonnes) from 2002/3 (= Scenario 2).
  - Euro 4 for all diesel vehicles (with US 2004 as alternate) from 2006/7 (= Scenario 2).
  - Increasing conversions to CNG/LPG in response to Government subsidies for vehicles >3.5 tonnes. (Up to 800 buses, 4000 commercial vehicles per year over the first four years) (= Scenario 2).
  - Business as usual growth scenario for VKT (= base case).

- Petrol quality assumptions –
  - Leaded petrol phased out by 1/1/2003 (= base case).
  - Sulphur 500 ppm (= Euro 2 sulphur level) from 2002
  - Euro 3 petrol from 2005. Specific, mandatory, requirements to be set for RVP, benzene, sulphur, aromatics and olefins, as outlined in Table 5.

Table 5: Euro 3 Specifications for Petrol

Parameter	Specification
RON, min	95
MON, min	85
Sulphur (ppm)	150
Distillation - evaporated at 100^0C, min (%vol)	46
Distillation - evaporated at 150^0C, min (%vol)	75
Oxygen content, max (%mass)	
RVP, summer period (max, kPa)	60
Benzene, max (%vol)	1
Aromatics, max (% vol)	42
Olefins, max (% vol)	18[1]
Oxygenates, max:	
Methanol (%vol)	3
Ethanol (%vol)	5
Iso-propyl alcohol (%vol)	10
Tert-butyl alcohol (% vol)	7
Iso-butyl alcohol (% vol)	10
Ethers containing five or more carbon atoms per molecule (% vol)	15
Other oxygenates (% vol)	10
Lead content (g/L)	0.005

1: Except for ULP with minimum MON of 81 and RON of 91, for which the maximum olefin content shall be 21% vol.
max: maximum
%vol: Percentage by volume
%mass: Percentage by mass

- 95 RON for all new vehicles from 2005/6.
- Euro 4 petrol from 2008 (all specifications mandatory). The Euro 4 specifications for petrol to be used for modelling purposes are outlined in Section 9.2.
- Increase in PULP demand for imported (and some locally produced) Euro 2/3 vehicles during 2000/2002 (= base case).
- Further increase in PULP demand from 2002, in response to a reduction in the PULP/ULP retail price differential to 2 c/litre (= base case).
- Reductions in petrol volatility in train or planned, following agreements with the States (= base case).

- Road transport diesel quality assumptions –
  - Voluntary reduction of sulphur in urban areas to 500 ppm through 2000/2, on a best endeavours basis (= Scenario 2)
  - Sulphur set at 500 ppm from 1/12/2002 (= Scenario 2).
  - 1 c/L excise advantage for 50 ppm sulphur diesel during 2003 (= Scenario 2).
  - 2 c/L excise advantage for 50 ppm sulphur diesel during 2004/5 (= Scenario 2).

- Euro 4 diesel from 2006 (all specifications mandatory). The Euro 4 specifications for diesel to be used for modelling purposes are outlined in Section 9.2.

- Off-road diesel quality assumptions –
  - 50 ppm sulphur from 2006. Current specifications continuing prior to 2006.

This scenario will also include estimates of the benefits that might be obtained by cooperation and linkage of the three East Coast pairs of refineries.

10.5 Scenario 5 – Euro 4 Transport Fuels By 2006

- Vehicle assumptions -
  - ECE compliance allowed as an alternative to ADR 37.01 from 2000 (= base case).
  - Euro 2 for all petrol vehicles < 3.5 tonnes (US 1996 HDV for >3.5 tonnes) from 2003/4 (= Scenario 2).
  - Euro 3 for all petrol vehicles < 3.5 tonnes (US 1996 HDV for >3.5 tonnes) from 2005/6 (= Scenario 2).
  - Euro 4 for all petrol vehicles 2008/9 (= Scenario 3).
  - 10% NAFC reduction 1990 to 2000 for cars (= base case).
  - Additional 10% NAFC reduction 2000 to 2010 for cars (= base case).
  - Additional 15% NAFC reduction 2000 to 2010 for cars, 4WDs and LCVs >3.5 tonnes (= Scenario 3).
  - Euro 3 for all medium and heavy diesel trucks (>3.5 tonnes)(with US 98 as alternate) from 2002/3 (= Scenario 2).
  - Euro 2 for diesel cars, light trucks and buses (<3.5 tonnes) from 2002/3(= Scenario 2).
  - Euro 4 for all diesel vehicles (with US 2004 as alternate) from 2006/7 (= Scenario 2).
  - Increasing conversions to CNG/LPG in response to Government subsidies for vehicles >3.5 tonnes. (Up to 800 buses, 4000 commercial vehicles per year) (= Scenario 2).
  - Business as usual growth scenario (= base case).

- Petrol quality assumptions –
  - Leaded petrol phased out by 1/1/2003 (= base case).
  - Sulphur 500 ppm (= Euro 2 sulphur level) from 2002 (= Scenario 2).
  - Euro 3 petrol from 2005. Specific, mandatory, requirements to be set for RVP, benzene, sulphur, aromatics and olefins, as outlined in Section 10.4.
  - 95 RON for all new vehicles from 2005/6
  - 98 RON for all new vehicles from 2008/9
  - Euro 4 quality from 2006. The Euro 4 specifications for petrol to be used for modelling purposes are outlined in Section 9.2.

- Increase in PULP demand for imported (and some locally produced) Euro 2/3 vehicles during 2000/2002 (= base case).
- Further increase in PULP demand from 2002, in response to a reduction in the PULP/ULP retail price differential to 2 c/litre (= base case).
- Reductions in petrol volatility in train or planned, following agreements with the States (= base case).

- Road transport diesel quality assumptions –
  - Voluntary reduction of sulphur in urban areas to 500 ppm through 2000/2, on a best endeavours basis (= Scenario 2)
  - Sulphur set at 500 ppm from 1/12/2002 (= Scenario 2).
  - 1 c/L excise advantage for 50 ppm sulphur diesel during 2003 (= Scenario 2).
  - 2 c/L excise advantage for 50 ppm sulphur diesel during 2004/5 (= Scenario 2).
  - Euro 4 diesel from 2006 (all specifications mandatory). The Euro 4 specifications for diesel to be used for modelling purposes are outlined in Section 9.2.

- Off-road diesel quality assumptions –
  - 50 ppm sulphur from 2006. Current specifications continuing prior to 2006.

10.6 Scenario 6 – Most Stringent Case

- Vehicle assumptions -
  - ECE compliance allowed as an alternative to ADR 37.01 from 2000 (= base case).
  - Euro 2 for all petrol vehicles < 3.5 tonnes (US 1996 HDV for >3.5 tonnes) from 2003/4 (= Scenario 2).
  - Euro 3 for all petrol vehicles < 3.5 tonnes (US 1996 HDV for >3.5 tonnes) from 2005/6 (= Scenario 2).
  - Euro 4 for all petrol vehicles 2008/9 (= Scenario 3).
  - 10% NAFC reduction 1990 to 2000 for cars (= base case).
  - Additional 10% NAFC reduction 2000 to 2010 for cars (= base case).
  - Additional 15% NAFC reduction 2000 to 2010 for cars, 4WDs and LCVs >3.5 tonnes (= Scenario 3).
  - Euro 3 for all medium and heavy diesel trucks (>3.5 tonnes)(with US 98 as alternate) from 2002/3 (= Scenario 2).
  - Euro 2 for diesel passenger cars, light trucks and buses (<3.5 tonnes) from 2002/3(= Scenario 2).
  - Euro 4 for all diesel vehicles (with US 2004 as alternate) from 2006/7 (= Scenario 2).
  - Increasing conversions to CNG/LPG in response to Government subsidies for vehicles >3.5 tonnes. (Up to 800 buses, 4000 commercial vehicles per year) (= Scenario 2).
  - Business as usual growth scenario (= base case).

- Petrol quality assumptions –
  - Leaded petrol phased out during 2002 (= base case).
  - Sulphur 500 ppm (= Euro 2 sulphur level) from 2002 (= Scenario 2).
  - Euro 4 quality (all parameters including volatility) from 2005. The Euro 4 specifications for petrol to be used for modelling purposes are outlined in Section 9.2.
  - Long term goal – 30 ppm sulphur by 2008.
  - Increase in PULP demand for imported (and some locally produced) Euro 2/3 vehicles during 2000/2002 (= base case).
  - Further increase in PULP demand from 2002, in response to a reduction in the PULP/ULP retail price differential to 2 c/litre (= base case).
  - 95 RON for all new vehicles from 2005/6 (= Scenario 2).
  - 98 RON for all new vehicles from 2008/9 (= Scenario 5).
- Reductions in petrol volatility in train or planned, following agreements with the States (= base case).
- Diesel quality assumptions (road and off-road) –
  - Voluntary reduction of sulphur in urban areas to 500 ppm through 2000/2, on a best endeavours basis (= Scenario 2).
  - Sulphur set at 500 ppm from end 2002 (= Scenario 2).
  - 1 c/L excise advantage for 50 ppm sulphur diesel during 2003 (= Scenario 2).
  - 2 c/L excise advantage for 50 ppm sulphur diesel during 2004/5 (= Scenario 2).
  - Euro 4 quality from 2005. The Euro 4 specifications for diesel to be used for modelling purposes are outlined in Section 9.2.
  - Long term goal - 30 ppm sulphur by 2008.

The six scenarios for fuel quality are summarised in Table 6.

Table 6 - Proposed Fuel Scenarios in Summary

Scenario	Description	2002	2005	2006	2008
1	Base case	Business as usual: 2 c/L PULP/ULP differential from 2002; LP out in 2002; RVP reduced as per State agreements. On road diesel: BP at 500ppm urban / 2000 ppm country in WA from 1/1/00; 500 ppm urban in Brisbane from 1/7/00, country Qld 2000. Other members: 1000 ppm av urban / 2000 ppm av country with +500 caps, from 1/1/00. Off road diesel: no change from present position.			
2	MVEC/MBE (Explicit) Option	Gasoline: 500 ppm S On road diesel: best endeavours to achieve metro diesel 500 ppm ahead of 1/12/02; 500 ppm for all on road from 1/12/02. Off road diesel; no change from present	Gasoline: 150 ppm S 95 RON for all new vehicles. On road diesel: excise reductions on 50 ppm S: 1 c/L in 2003; 2 c/L in 2004/5 Off road diesel; no change from present	On road diesel: 50 ppm S Off road diesel: 50 ppm S	
3	Best Endeavours MVEC/MBE (Implicit) Option	Gasoline - 500 ppm sulphur On road diesel - 500 ppm sulphur Off road diesel; no change from present	As for Scenario 2 but also: Gasoline: Euro 3 with specific requirements for RVP, benzene, sulphur, aromatics and olefins. Specifications for parameters other than S based on best cost/benefit breakpoints for each refinery. 95 RON for all new vehicles	On road diesel with specific requirement for 50 ppm sulphur. Specifications for parameters other than S based on best cost/benefit breakpoints for each refinery. Off road diesel: 50 ppm S.	Euro 4 petrol specifications other than sulphur based on best cost/benefit breakpoint for each refinery.
4	Mandatory MVEC/MBE (Implicit) Option	As for Scenario 3	As for Scenario 3 but set specifications for all parameters to be mandatory	As for Scenario 3 but set specifications for all parameters to be mandatory	Euro 4 petrol specifications mandated.
5	Euro 4 Transport Fuels by 2005	As for Scenario 3	As for Scenario 3	As for Scenario 3 but also: Gasoline: Euro 4	98 RON for all new vehicles
6	Most stringent	As for Scenario 3	Gasoline: Euro 4 complete RVP=60 kPa All diesel: Euro 4 complete		98 RON for all new vehicles. Gasoline: 30 ppm S All diesel: 30 ppm S

REFERENCES

- MVEC (1999), *Review of Motor Vehicle Emission Standards, Recommendations to NRTC and NEPC.*
- MVEC (1999), *Revised Emission and Fuel Standards Package.*
- American Automobile Manufacturers Association, European Automobile Manufacturers Association, Engine Manufacturers Association and Japan Automobile Manufacturers Association, (1998) *World Wide Fuel Charter.*
- FORS/EA (1997), *Petrol Volatility Project - Supplementary Report No.2 to Motor Vehicle Pollution in Australia Report*, report prepared by the Environment Protection Authority of Victoria for the Federal Office of Road Safety and Environment Australia, November 1997.
- Australian Institute of Petroleum (1997), *Refinery Product Characteristics*.

APPENDIX A

LETTER TO STAKEHOLDERS

Dear

RE:

I write to advise you that Coffey Geosciences have been engaged by Environment Australia to undertake a review of motor vehicle fuel quality in Australia. The review will be carried out in 1999 and will consider fuel quality changes over the next ten to twenty years. We wish to invite comment from your organisation regarding future Australian fuel quality changes.

The object of the study is to assess changes in air pollution emissions which would occur as a result of various levels of improvement of motor vehicle fuel quality. The review will consider potential changes to the motor vehicle fuel formulation over this period and consider the effects of such changes on emissions from refineries and the Australian motor vehicle fleet, and the impact of changes to the cost of production of fuel. Changes in the cost of production will be assessed in consultation with the petroleum industry and will address the additional refinery plant and operating costs which would be incurred to deliver improved fuel quality. The attached statement prepared by Environment Australia and which appeared in 'Clean Air' (the journal of the Clean Air Society of Australian and New Zealand) in February 1999, provides a brief description of the objectives and background of the study.

Interaction with stakeholders is an essential part of this study and as part of this process we seek input from your organisation. A series of scenarios are being developed to represent the range of likely changes in fuel quality over the next ten years. These scenarios will address conditions ranging from:

- a baseline scenario in which only existing commitments for improvements in fuel quality take place, to
- a scenario in which Australian motor vehicle fuel quality is consistent with planned European Euro 4 standards by 2006.

Improvements in fuel quality considered will include:

- reduction in sulfur content for petrol and diesel,
- reduction in volatility of petrol,
- reduction in aromatic content of petrol, and
- inclusion of oxygenates.

Phase out of leaded fuel will be assumed for each scenario.

We seek a point of contact within your organisation and we invite comment in relation to the fuel quality scenarios to be assessed. The attached questionnaire provides for nomination of a contact person from your organisation and provides an opportunity for comment on what your organisation views as the critical issues with respect to Australian fuel quality over the next ten years.

Inquiries in relation to this project should be directed to Ms. Frances Kavanagh or the undersigned at the Sydney offices of Coffey Geosciences. The contact details are listed below:

Coffey Geosciences Pty Ltd
PO Box 125
NORTH RYDE NSW 1670
phone (02) 9888 7444
fax (02) 9888 9977
email fuel_study@coffey.com.au

This is clearly an important study which provides your organisation with the opportunity to assist government in development of a fuel policy best suited to the Australian context. We look forward to any comments or suggestions you may have.

For and on behalf of
COFFEY GEOSCIENCES PTY LTD

ROSS BEST
Senior Principal
Project Manager – Australian Fuel Quality Review

Attachments:
Environment Australia release: Review of Fuel Quality Requirements for Australian Transport Commences
Contact Details Response form

APPENDIX B

LIST OF STAKEHOLDERS

- ACT Department of Urban Services
- AGL
- AIR
- Aust Automobile Association
- Aust Competition & Consumer Commission
- Aust Institute of Petroleum
- Aust LPG Association
- Aust Natural Gas Vehicles Council
- Aust Petroleum Agents & Distributors Assoc.
- Aust Service Station Association
- BP Australia
- Burmah Fuels
- Burn Bank Consulting
- Caltex Australia
- Commecial Vehicle Industry Association
- Commonwealth Department of Industry Science & Resources, Petroleum Division
- Commonwealth Department of Industry, Science and Resources, Automotive Industry Section
- Conservation Council of WA
- CSIRO
- Department of Environment & Heritage, Qld
- Department of Environment & Land Management, TAS
- Department of Environmental Protection, WA
- Department of Infrastructure, Energy and Resources, Tas
- Department of Lands, Planning & Environment, NT
- Department of Natural Resources, Victoria
- Department of Transport, Queensland
- Dept. of Transport, Tasmania
- Department of Transport, WA
- Department of Transport & Works, NT
- Department of Transport, the Arts & Urban Planning, SA
- Environment Protection Authority, NSW

- Environment Protection, Dept of Urban Services, ACT
- Environment Protection Authority, Victoria
- Federal Chamber of Automotive Industries
- Federal Office of Road Safety
- Federation of Automotive Products Manufacturers
- Gull Petroleum WA
- Iain Cameron Consultancy
- Liberty Oil Pty Ltd
- Minerals & Petroleum Dept of Natural Resources & Environment, Victoria
- Minerals Council of Australia
- Mobil Oil Australia
- Motor Traders Association of Australia
- National Environmental Consultative Forum
  C/- Tas. Conservation Trust, Inc.
- National Farmers Federation
- National Road Transport Commission
- NRMA
- NSW Cabinet Office
- Premiers Department
- Road Transport Forum
- Roads & Traffic Authority – NSW
- Shell Australia
- Society of Automotive Engineers
- Sustainable Energy Group
- The Treasury
- Victorian Farmers Federation
- VicRoads

APPENDIX C

SUMMARY OF THE KEY ISSUES NOMINATED BY THE STAKEHOLDERS

Stakeholder	Date Response Received	Key Issues Nominated
ACT Dept of Urban Services		
AGL	6/05/99	Establishing current social and health costs of transport related emissions; cost benefits of fuel quality improvements; effects of fuel specification changes on emissions of air toxics; ensuring effectiveness of the Federal Government's policy on alternative fuels.
AIR		
Australian Automobile Association		
Australian Competition & Consumer Commission	9/04/99	No comments offered
Australian Institute of Petroleum	19/03/99	Detailed paper produced; included in Appendix.
Australian LPG Associatioon	15/04/99	Governement alternative fuels policy; potential for gaseous fuels relative to diesel due to reduction in diesel excise
Austrtalian Natural Gas Vehicles Council		
Australian Petroleum Agents & Distribution Association	4/05/99	No comments offered
Australian Service Station Association		
BP Australia		
Burmah Fuels	9/04/99	No comments offered
Burnbank Consulting	29/03/99	Diesel fuel quality; impact on bus and coach industry; in-service emissions from buses and coaches
Caltex Australia		As per AIP comment. Also stressed the importance of feeding the output from the fuel quality review into the MVEC process and the Downstream Petroleum Products Action Agenda
Commonwealth Department of Industry, Science and Resources	22/03/99	Fuel specification impacts on refinery viability
Commonwealth Vehicle Industry Association		
Commonwealth Vehicle Industry Association NSW	19/05/99	Support for the review offered. Members in the oil industry to reply direct.
Conservation Council of WA	27/04/99	Urban air quality; health effects of fuel emissions. The study needs to address the elimination of lead from petrol, lowering of sulphur levels in diesel, lowering of benzene levels in petrol, lowering of RVP, exclusion of oxygenates such as MTBE due to potential health impacts, and the provision of standards for alternative fuels.

Stakeholder	Date Response Received	Key Issues Nominated
CSIRO		
Dept of Environment & Heritage, Qld		
Dept of Environment & Land Management, Tasmania		
Dept of Environal Protection, WA		
Department of Infrastructure, Energy and Resources, Tas	24/03/99	Greenhouse gas emissions; urban air pollution; demand implications, economic and employment effects of increased fuel costs; achievable improvements from changes to fuel specifications
Dept of Lands, Planning & Environment, NT	12/04/99	Cost implications of changes to fuel quality specifications to regional Australia.
Dept of Transport & Works, NT	25/03/99	Impact on regional Australia; that full consideration of the results of this study occurs before decisions are made on final emission standards
Dept of Transport, Qld		Impact of reduction of sulphur in diesel, reduced petrol volatility, particle emissions PM10 and PM2.5, air toxics emissions, introduction of non-lead super fuel, wider economic impacts of failure to harmonise with world emission and fuel standards.
Dept of Transport, Tas	24/03/99	
Dept of Transport, Tas		
Dept of Transport, WA	9/04/99	Lower petrol volatility, sulphur in diesel, limits to benzene and other pollutants
Dept Transport, Arts & Urban Planning, SA		
Dept. Natural Res., Vic		
Environmental Protection Authority NSW	16/04/99	Timelines of information from the study in regard to the review of the ADRs; accurate and timely quantification of the options, costs and timelines for introducing tighter specifications for fuel; high level of transparancy and credibility from a technical and public policy perspective; accurate information on the link between emerging vehicle technologies and fuel quality; assessment of the impact of the increasing links internationally between the oil industry and vehicle manufacturers.
Environ Protection, ACT		
EPA		

Stakeholder	Date Response Received	Key Issues Nominated
Federal Chamber of Automotive Industry		
Federal Office of Road Safety	15/04/99	Fuel requirements which may be necessary to deliver, on the road, the emission limits imposed by the ADRs. Sulphur in diesel is the critical issue in the short term (3 to 4 years). In the longer term, future reductions in sulphur in diesel and petrol, diesel density, petrol volatility, octane and toxics are likely to be key issues.
Federation of Automotive Products Manufacturers		
Gull Petroleum WA		Importance of stakeholder consultation, impact of the new fuel specification on the ability to import fuels into Australia; that the independent oil companies are not impeded by any new legislation relative to the major oil companies.
ISR, Automotive Industry Section		
ISR, Petroleum Section	22/03/99	Fuel Specification impacts on refinery viability. No comments to offer.
Liberty Oil Pty Ltd	24/03/99	Availability of fuel overseas which meets the specifications for unleaded petrol in Australia
Minerals Council of Aust		
Mobil Oil Australia		
Motor Traders Assoc of Aust	26/03/99	Impact of any changes on retail motor traders
Nat. Environal Consultative Forum, Tas		
National Farmers Federation	10/05/99	Transport
National Road Transport Commission		
NRMA	6/04/99	Cost of increasing the market volumes of PULP; production of fuels in Australia in time to meet vehicle emission standards; practicality and economics of having only one grade of ULP at 95 RON available nationally
NSW Cabinet Office		
Premiers Deptartment NSW	8/04/99	Air quality, greenhouse, employment , investment opportunities, sustainable technologies
Road Transport Forum	25/03/99	Possible increased price of diesel; timing of the introduction of Euro 2, 3 and 4 fuel standards and diesel emission standards; focus on heavy vehicles vs LCVs and diesel passenger vehicles

Stakeholder	Date Response Received	Key Issues Nominated
Roads & Traffic Auth – NSW		
Shell Aust		As per AIP comments. Timing of the fuel quality review with respect to the MVEC study. Consideration of Euro 4 is vital so that the total cost to industry is recognised and the impact on future viability can be gauged.
Soc of Automotive Engineers		
Sustainable Energy Group		
The Treasury		
Victorian Farmers Association	27/04/99	Cost implications to farmers, cost implications in rural areas.
VicRoads		Impacts on freight operating costs, transport efficiency, choice and efficiency of mode of transport (road/rail) for freight transport, identification of criteria for fuel specifications (eg safety), landuse planning in distribution systems